No. 2045 Vol. LIII

MARCH 4th, 1948

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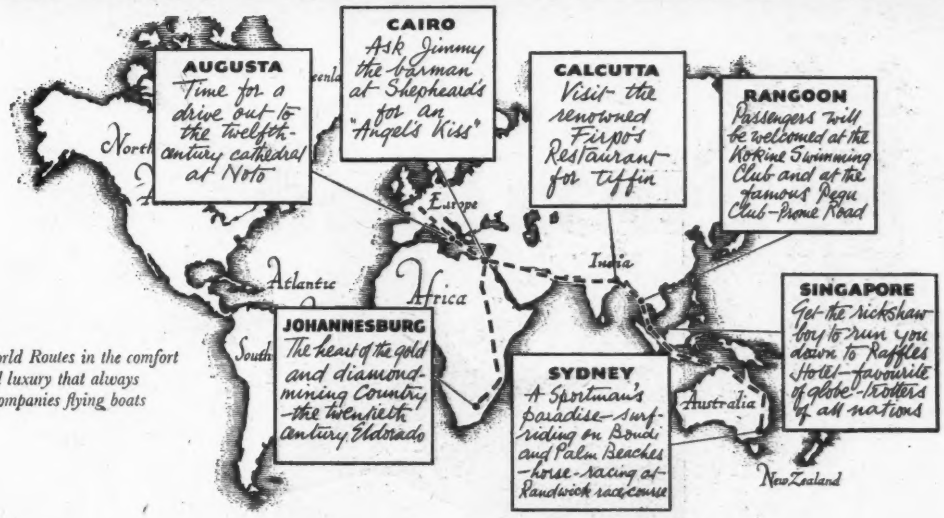
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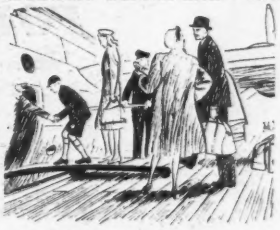

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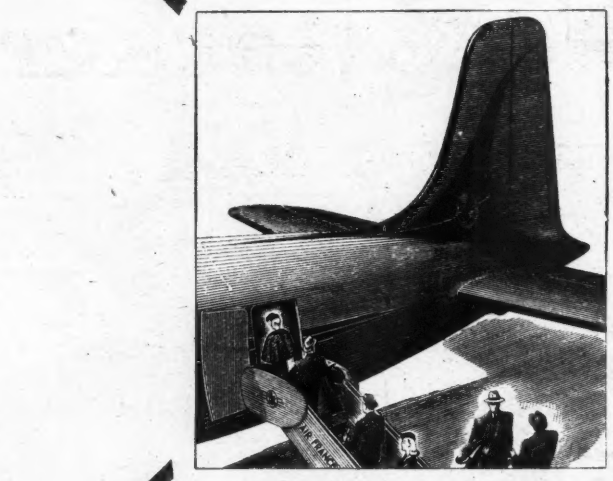
His flying career began in 1927, when he flew Avro 504Ks with the R.A.F. Later, he had his first taste of "marine aircraft" with the Fleet Air Arm, flying Blackburn Blackburns and 3Fs.

Captain Upton was one of the B.O.A.C. captains who assisted in the evacuation of Crete, camouflaged "C" class boats being used for the job.



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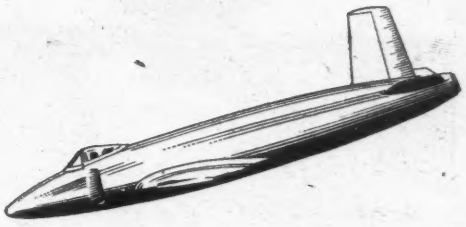
The 'Attacker'

makes Aviation History



New closed circuit record of 564·88 M.P.H.

On 27th February, in the fastest closed circuit flight ever made, the Vickers Supermarine 'Attacker' jet fighter set up a new record of **564·88** m.p.h. for the International 100 km. Closed Circuit. The machine carried full military equipment and was powered by a single Rolls-Royce 'Nene' turbo-jet operating at its standard rating.

(Subject to official confirmation)

The new record, together with the recent series of successful deck landings on H.M.S. 'Illustrious,' establishes the outstanding manoeuvrability of the 'Attacker' at both high and low speeds.

AT31

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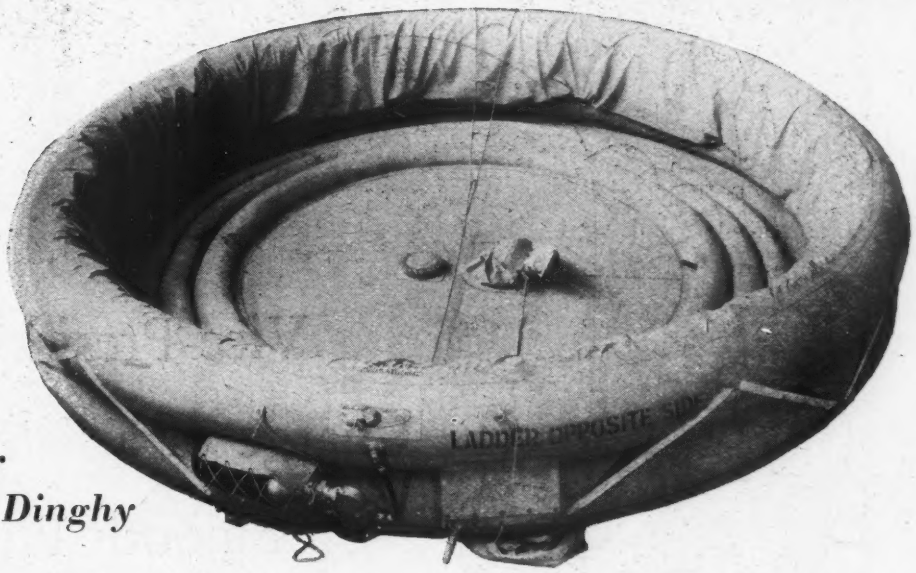

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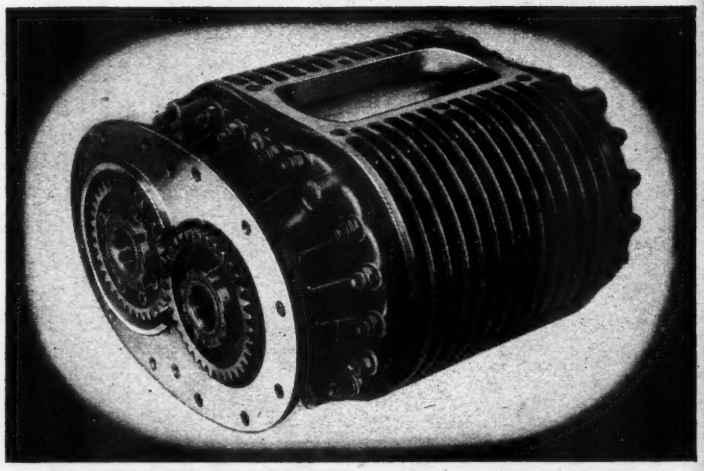

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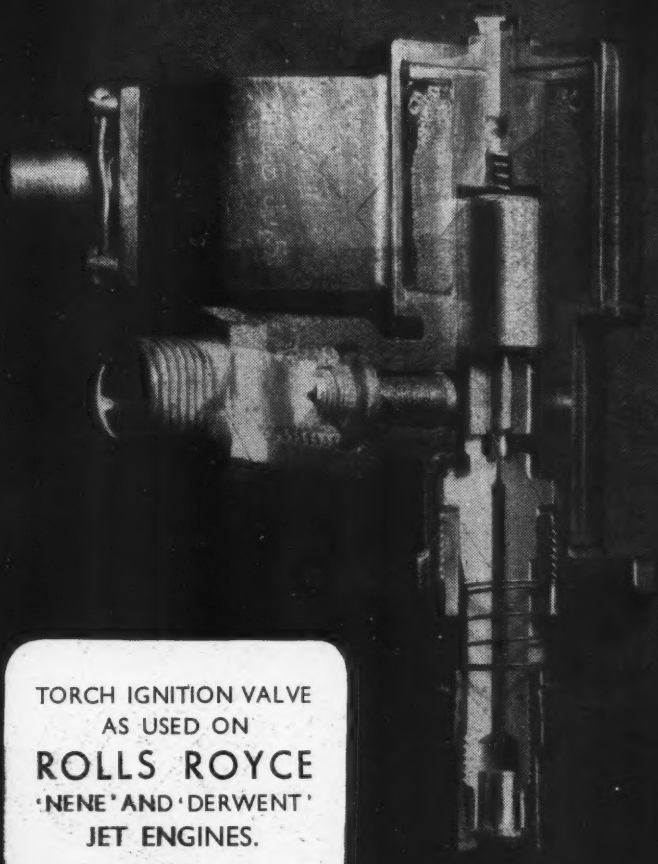

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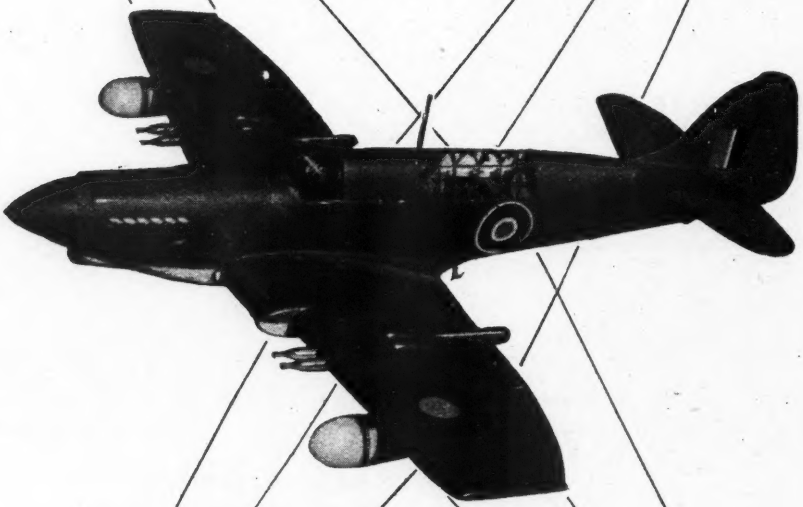

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The Outlook

That Mobile Striking Force

THERE is little comfort to be derived from the 1948-49 Air Estimates. The net total of expenditure is large enough in all conscience at £173 million, but the general picture is such that even a much larger sum would have been preferable if one could have the feeling that we really are making rapid headway with the reorganization of the R.A.F. As it is, one is left with the impression that, by force of circumstances, we are driven to attempting the impossible task of cutting-down and increasing the R.A.F. at the same time.

Lord Trenchard's dictum of many years ago about an efficient air force cutting its way through an inferior enemy as a knife cuts through butter was proved correct by the eight-gun fighters in the early part of the last war. The emphasis then was on defence. The situation has now changed, and the Air Minister has announced, in his Memorandum on the Air Estimates, that the aim now is "to enable a substantial weight of air power to be developed at short notice in any area where it may be required." In other words, the emphasis has shifted from defence to offence.

With that policy no one will quarrel. It is obviously the right one in present circumstances. But it does not fit in very well with the Air Minister's statement that "the operational Commands of the Air Force will continue to develop and practise improved methods for obtaining the maximum effectiveness from the aircraft with which they are equipped." In the heavy bomber class we have nothing but the Lincoln, a type which, good as it was in 1945, can scarcely be expected to remain the right machine for 195?. That the Estimates provide for further re-equipment of fighter squadrons with jet-propelled aircraft is welcome news. Less reassuring is the statement that provision is also made for "a limited measure of re-equipment elsewhere." This is too vague to give much comfort. It may not be unconnected with the explanatory notes on Vote 7, which state that the decrease in the Vote "is mainly due to a greater allowance being made for technical and other difficulties in achieving programmes." That sentence refers, of course, to the whole of Vote 7, which includes many items other than aircraft and engines, but it is significant that by far the greatest reduction (£4,020,000 compared with the 1947-48 Estimates) applies to the provision for aircraft and engines. There is a very ominous ring about the phrase "technical and other difficulties in achieving programmes."

Service Difficulties

SOMBRE as is the re-equipment picture, it is matched by personnel problems in the Royal Air Force. Mr. Henderson explains in his Memorandum that at the end of the war the regular elements of the R.A.F. numbered less than 40,000. This figure has now been raised to about 100,000 but some 135,000 are being released or discharged during 1948, so that by the end of the year the force will have lost a high percentage of the trained personnel it possessed at the end of the war, and the regular element will still be only about 40 per cent of the total.

The Air Minister is quite frank about the position. He states: "The average level of experience is low, postings are frequent, and dilution is high. It is of the utmost importance that the process of building up the regular content should not be delayed. Efficiency and economy can only be restored when the training effort can be limited to meeting normal replacements in a stable force."

Conscription, or as the modern euphimism prefers to call it, National Service, is of no use whatever in the R.A.F. In fact, it is a hindrance rather than a help. The period of service is too short, and the fact that the conscripts must be taught something of trades which afterwards may be of use to them in civil life prevents

the Service from employing them in the only ways which their lack of skill would logically dictate.

The problems are, as Mr. Henderson explains, complicated by the fact that, owing to the operation of the age and service system of releases, and the widely differing periods of training in the different trades, there is not only an overall shortage of trained men, but a lack of balance between trades, which seriously disorganises the work of units. It is not of very much help to throw the onus, as the Air Minister tends to do, upon the officers and airmen by pointing out that efficiency depends in a large measure on the organization on the spot and the spirit of the unit. That is merely asking willing personnel to do the impossible, their only reward being a tribute "to the way all ranks in the force have risen to the occasion, and have shown that by hard work and improvization they can defeat the difficulties of the reconstruction period."

Civil Aviation

LAST Thursday's debate in the House of Commons on Civil Aviation ranged far and wide. It cannot, however, be said that it contributed a great deal towards clarifying the present muddle. All were agreed that the Corporations must be expected to lose money, but that they have lost more than they need have lost. There was, however, no general agreement as to how reductions are to be brought about.

The system of ordering aircraft was criticized by many, and Mr. Strauss announced that three business men have been asked to advise on the matter: Mr. Hanbury-Williams, Sir Rowland Smith, and Mr. George Wansbrough. When they have reported, and the Government has considered their views, an official statement will be made.

The House showed a general desire that the question of buying D.C.4Ms should be studied, and Mr. Lindgren promised that, now that the proposition had been made, he will report to the Minister, who in turn will call the attention of the Government to the statements made.

Criticism was also levelled at the Ministry of Civil Aviation, which was originally intended to be a small, compact Ministry but will soon, it is said, employ some 4,000 people.

Several speakers pleaded for the abolition of the petrol tax for internal flying, but Mr. Lindgren stated definitely that the Government has decided against the abolition. We believe this to be a short-sighted policy, and cannot agree with the Parliamentary Secretary as to its fairness. The flying clubs, now definitely denied financial aid, will be hit in addition to the industry.

In connection with the disappearance of the *Star Tiger* Mr. Lindgren announced that there is to be a formal court investigation, held by Lord Macmillan. Apart from its findings, it is to be hoped that the report of the court will equal in the clarity and precision of its English Sir John Simon's report on the loss of the airship R.101.

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"Flight" photograph.

GUNSIGHT: Built to an Army specification by The Heston Aircraft Company, the A.2/45 Artillery Observation Post with D.H. Gipsy Queen engine offers an exceptional all-round field of vision from its two-seat (back-to-back) cockpit. The manoeuvrability and slow-flying characteristics are also noteworthy features. The pilot can maintain continuous radio contact with both gun batteries and base.

A world-beating combination—the Vickers-Supermarine Attacker, with Rolls-Royce Nene turbo-jet, and Mr. M. J. Lithgow, ex-Fleet Air Arm Vickers-Supermarine test pilot.

PROVOKED ATTACKER

Vickers-Supermarine Jet Fighter Averages 564.881 m.p.h. over 100-Km Closed Circuit

Illustrated by "Flight" Photographs

YET another brilliant demonstration of the speed and handling qualities of a British jet fighter was provided at Chilbolton last Friday by Mr. M. J. Lithgow in a Vickers-Supermarine Attacker, propelled by a Rolls-Royce Nene turbo-jet. "TS 409," the first Attacker prototype, remembered for its vivid displays at Radlett, Brussels and Lee-on-Solent, completed a 100-km closed circuit at an average speed of 564.881 m.p.h., thereby (subject to F.A.I. confirmation) wresting the international record for this course from the Meteor, which, in its turn, had won it from the Vampire.

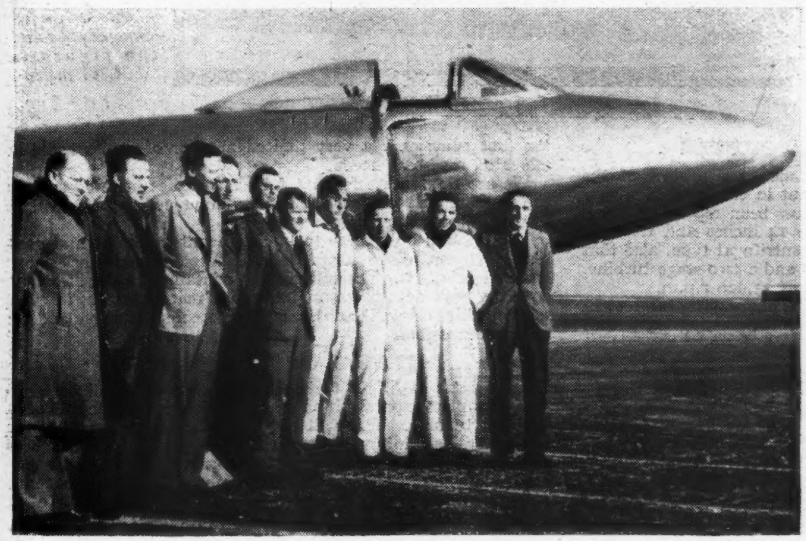
The performance was preceded on the Thursday by a lap at 560.634 m.p.h. and is the more creditable in view of the tractability displayed by the Attacker in its deck-landing trials, reported in *Flight* of November 13th last year. Warming memories of joint Supermarine-Rolls-Royce successes in bygone Schneider Trophy contests are evoked.

On Thursday, after a reasonable, though far from perfect, weather report from Messrs. Morgan and Colquhoun in the yellow Spitfire Trainer, Royal Aero Club officials and time-keepers and the R.O.C. turning-point observers stood to their posts, having been fully briefed, together with Mr. Lithgow, by Colonel R. L. Preston.

Before entering the cockpit in the lobster-claw nose of the Attacker, "Mike" Lithgow forecast his time (having regard to the wind and weather) as 6 min 39 sec. The Nene inhaled the chilly air, found it good, and with the ground-running louvres opening to guard against depression in the plenum chamber, roared up to its full 5,000 lb static thrust. When the brakes were released for take-off, the all-silver fighter was seemingly catapulted along the runway, to become airborne well before reaching the last of the enfilading photographers.

The course, flown anti-clockwise, was marked by turning points at (A) the control tower at Chilbolton, (B) Pepper Box Hill on Witherington Down, south of West Grinstead, (C) the intersection of the runways at Ibsley airfield, and (D) the concrete tower at Arnewood Sway, near Lymington. Confirmed by the county surveyor, the precise distance was 100.136 km (62.235 miles).

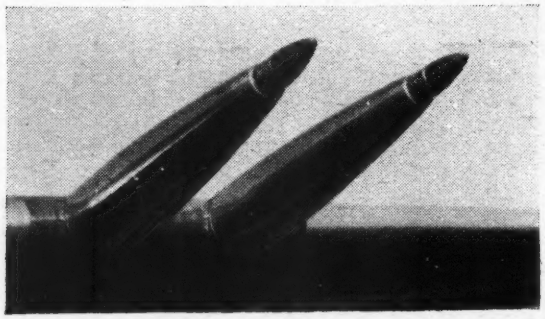
Visibility was such that from 500ft Lithgow was unable to see each succeeding turning point from the preceding one, though this had been possible on practice flights. On the first leg he lined up the Attacker with the Chilbolton runway and steered



"Mike" Lithgow with members of the Supermarine and Rolls-Royce teams which prepared the victorious Attacker.

Provoked Attacker . . . . .

a course by his Sperry Gyrosyn compass. With the A.S.I. showing about 575 m.p.h. the Attacker whistled and thundered over the snow-flecked countryside. It was exasperating not to be able to see the turns, for they were timed almost to the split second, and Lithgow was taking them at about 4g. The minutes ticked by and at the declared second a silver shape streaked past Control, where vigorous pyrotechnic aid was



The faired muzzles of the 20 mm Hispano Mk V guns.

being applied, and described triumphant 6g circles within the airfield perimeter.

The teams which had designed, built and prepared the Attacker paid spontaneous tribute. Mr. J. Smith, Supermarine Chief Designer, and Jeffrey Quill, Chief Test Pilot, who was recovering from a jaw operation, were prominent. Lithgow commented briefly on a bumpy ride (the wind had been gusting up to 30 m.p.h.) and declared his intention of going round again if conditions improved later.

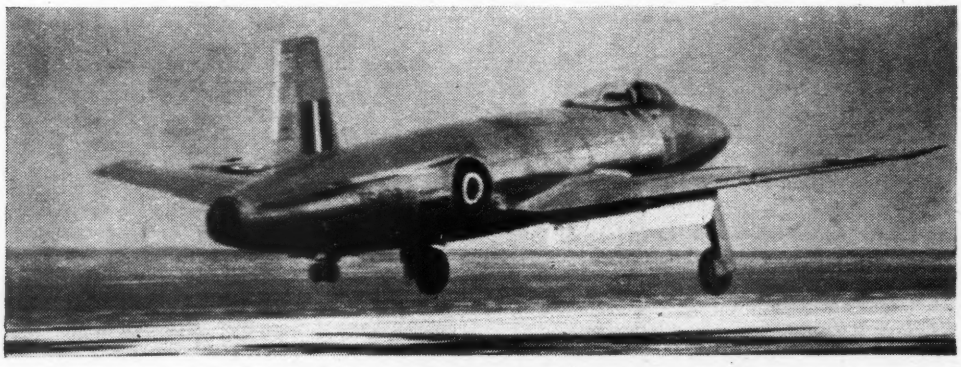
Nearing sundown, the wind slackened, though visibility remained poor, and once more the frosty hills threw back the note of the Nene. This time, however, Lithgow was

The beautifully shaped cockpit enclosure, with its faired windscreen.

denied success. Visibility degenerated to the point of impossibility on the last leg.

Next day (Friday), Lithgow was out again in the Attacker, but difficulty at one of the turns thwarted him. Later he took up the Spitfire Trainer for a weather check and, finding the wind light and the visibility improved, started off again in the Attacker, passing Control on the first leg at 12.33 p.m. This time he completed the course at 564.881 m.p.h., and at that figure—subject, of course, to confirmation—the 100 km closed circuit record now stands. There is no doubt that, under ideal conditions, the Attacker could improve on this speed by at least 5 m.p.h.

On each of the record bids, the machine was flying at its normal all-up weight of 11,300 lb and carried its full armament of four 20-mm Hispano Mk. V guns, with ballast in place of ammunition. The makers continue to claim a maximum sea-level speed of 590 m.p.h. (561 m.p.h. at 20,000ft) though the true speed at low level, with the new rounded windscreen and faired gun muzzles, is probably nearer 600 m.p.h. As pointed out when the Attacker was described in *Flight* of May 15th, 1947, the aircraft holds great promise of development. Already drawings have appeared of a version having the mainplanes and tail surfaces sharply swept back in order to raise the critical Mach Number, and the capacity of the fuel system to deal with a flow of 900 gallons an hour, in conjunction with other features of the Attacker's design, should permit the installation of a Nene of even greater thrust than the present Mark.



Lithgow sets the Attacker down on the Chilbolton runway after a 100-km circuit at 560.634 m.p.h. On the following day he raised the figure to 564.881 m.p.h.

BRITISH 250 H.P. TURBINE

IN September last reference was made to a project of the National Gas Turbine Establishment in the form of a very small 250 h.p. gas turbine. It has now been reported abroad that the maximum diameter is to be 14 inches and that the compressor is to be of the two-stage centrifugal type, also that it is to have six combustion chambers and a two-stage turbine. Operating speed will be in the region of 35,000 r.p.m.

It is understood that certain revolutionary structural techniques are to be employed, including the casting as a unit of the turbine, its stub shaft and blades to form.

F.B.I. REGISTER OF BRITISH MANUFACTURERS

THIS comprehensive reference book, the first post-war edition of which was recently published (Kelly's Directories, Ltd., and Iliffe & Sons, Ltd., £2 2s.), provides a most valuable cross section of British industry. It met with an immediate demand both in this country and abroad, but from the first print only a very limited number of copies could be allocated for home needs.

We are now informed that further supplies have come from the binders and of these a few hundred copies only will be available for home sales.

The book is invaluable to buying agents at home and overseas, shippers, distributors, technical reference libraries, and trade associations. The information contained in the directory, covering as it does the most important manufacturers in every section of industry, is at the same time comprehensive and yet readily accessible.

DETAILS OF THE MAMBA

IN the issue of *Flight* to be dated March 18th will be found a complete appraisal of the Armstrong Siddeley Mamba airscrew turbine. This will be the first occasion on which an illustrated description of a power unit of this type has been permitted without restriction on information. Specially prepared cutaway drawings of the Mamba and its components, and diagrams which complement the description of their method of operation, will be of great interest to all readers.

HERE AND THERE

Copenhagen Show

THE S.B.A.C. have arranged to take a stand, on which will be exhibited a selection of the products of the British aircraft industry, at the Copenhagen Show which is to open on September 18th and will last until October 3rd. This will be the limit of the participation of British aircraft manufacturers in this exhibition.

T.E.A. Flying Boats

THE Tasman Empire Airways flying boats, which were reported on this page last week as having been withdrawn from service for engine modifications, are fitted with American Pratt and Witney Twin Wasp engines. They are known as Tasman-class flying boats in New Zealand and are identical with the Plymouths operated by B.O.A.C.

Dutch Navy Fireflies

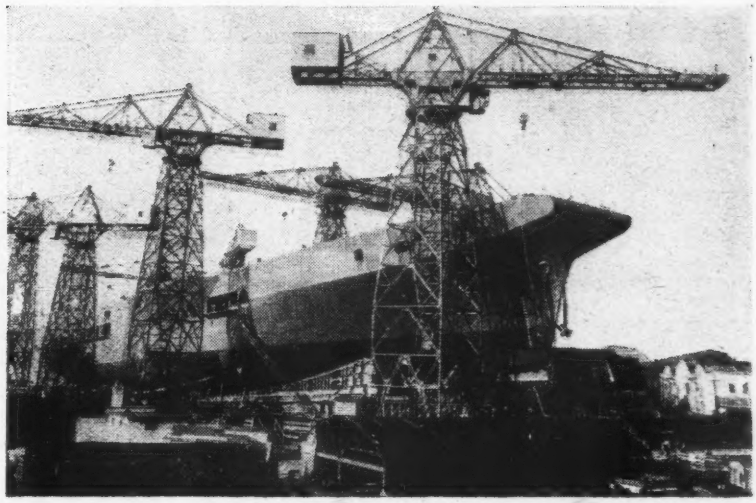
A FURTHER order for a substantial number of Fairey Firefly Mk. IV (Rolls-Royce Griffon) fleet reconnaissance general purpose fighters has been placed by the Dutch Government with the Fairey Aviation Co., Ltd. This order supplements previous orders for Firefly aircraft, which were first delivered to the Air Arm of the Royal Netherlands Navy in January, 1946.

Report on Loss of Singapore

IN his report on the fall of Singapore A.V-M. Sir Paul Maltby, Assistant A.O.C. Far Eastern Command, R.A.F., said that in the absence of the Fleet, defence of the Far East depended primarily on a mobile air defence. The Japanese attack came when the Army and the Air Force had only received part of the modern equipment and reinforcements which had been estimated to be necessary. The army had insufficient troops to defend the Malayan airfields which subsequently proved invaluable to the enemy and their loss proved to be the prelude to the loss of the fortress.

Vokes, Ltd., Meeting

VOKES, LTD., held their annual general meeting on March 2 at the Lion Hotel, Guildford. The net profit for the year totalled £10,296 8s 6d and a dividend of 12½ per cent on the ordinary shares was recommended. Mr. C. G. Vokes, managing director, in his speech referred to tests carried out on a car engine by an independent firm of consulting engineers; these tests were made under dust conditions approximating to those of an English road. The results proved that apart from increasing the engine's life, very striking economies in petrol and oil were possible; percentage savings quoted were 15.2 and 75 respectively for petrol and oil. Assuming there were a million private cars and a million and a half commercial vehicles on the roads the savings of petrol and oil would, following up the figure he had quoted, represent a figure of over £3,000,000. What is believed to be the first privately owned wind tunnel has been erected for testing air filters under dust conditions at high velocities.



***STILL IN THE FAMILY:** Instead of going into service with the Royal Navy, the new aircraft carrier, H.M.S. "Terrible," now nearing completion at Devonport dockyard, has been sold to Australia.*

Napier Dividend

IN the report of the 29th Ordinary General Meeting of the English Electric Co., Ltd., reference is made to the results of D. Napier and Son, Ltd., an associated company. A dividend of 7½ per cent is declared for the Napier ordinary shares. Sir George Nelson, F.C.G.I., M.I.Mech.E., M.I.E.E., chairman and managing director of English Electric, said that he could not speak too highly of the Napier staff in their energy and enthusiasm in tackling the many technical problems associated with modern aero-propulsion units.

News in Brief

A contract valued at over £2,000,000 for the construction of a new civil airport at Changi, Singapore, has been given to Gammon (Malaya), Ltd., a firm of Malayan civil engineers, by the Air Ministry. The contract is expected to take two years to complete.

* * *

The petition for the compulsory winding-up of Miles Aircraft, Ltd., has been adjourned until after Easter by Mr. Justice Roxburgh, in the Chancery Division. The creditors' petition has been before the court on four previous occasions and has been adjourned for the completion of a scheme of arrangement between the company, its shareholders and creditors.

The Ministry of Civil Aviation has confirmed the licensing of extensions at Cowes Airport, Isle of Wight; the total length of north-south run is now 1,200 yards.

* * *

Mr. D. J. Lloyd Davies has left British Air Transport, Ltd., and, with Mr. R. Pierce, late of British Aviation Services, Ltd., has been appointed Sales Executive with the Lancashire Aircraft Corporation.

* * *

Mr. F. N. Hillier, Publicity Controller of B.O.A.C., will lecture before the Yorkshire Section of the Institute of Transport on March 9th. His subject will be "Some Current and Future Problems of Air Transport." The lecture will be at 6.30 p.m. at the Gt. Northern Station Hotel, Leeds.

* * *

B.O.A.C. has acquired an interest in the Bermuda Development Co., which controls three of the island's leading hotels, the St. George, the Castle Harbour and the Bermudian. An agreement upon the accommodation to be made available for B.O.A.C. passengers has been reached.

* * *

A partly dismantled Rapide belonging to a British charter company was, on February 24th, flown by Cie Air Transport, of Paris, from Vichy to Croydon via Le Bourget in a Bristol Freighter. This is the second operation of this kind; a crashed Consul was brought back from Spain in the same way at the end of last year, a photograph of which appeared in *Flight*, January 8th.

On Airborne Refuelling

The Possibilities of Flight Refuelling Discussed

By ROY PEARL

AT the fourth attempt to refuel in flight on a North Atlantic scheduled crossing the operation was for the first time unsuccessful; but the failure served to expose the complications and difficulties associated with the scheme, without prejudice to the theory that it is a practical proposition and possibly a future necessity. The Ministry of Civil Aviation have considered for some time that flight refuelling should be thoroughly investigated, and after negotiations with B.S.A.A. and later with B.O.A.C. it was agreed to fly experimental schedules across the South and the North Atlantic. The former have already been described. The analysis of the North Atlantic trials will undoubtedly be interesting and provide useful data, but in my opinion they can in no way be conclusive.

On February 14th the fourth crossing was made. The receiver Liberator was due to leave London Airport at 05.00 hours, refuel for the first time 500 miles west of Ireland, and for the second time off the coast of Newfoundland. Lancastrian tankers owned by the M.C.A. and operated by Flight Refuelling, Ltd., were based one each at the three airports: Shannon, Gander and Goose Bay. On the Saturday morning the weather situation was one of the most complicated that could be encountered, even for the North Atlantic, with westerly winds reaching 90 m.p.h. After the first flight plan had been drawn, it was found impossible for the Liberator to fly the Great-Circle route from London to Montreal with a safety range margin, even after refuelling twice in the air. Captain E. H. Jones then decided to fly a pressure-pattern route, which would take us North and very close to Iceland. London Airport does not forecast weather for the North Atlantic; this is normally done at Shannon and Prestwick, and a new weather map was necessary for the flight plan for the Northerly route.

Since B.O.A.C. have not yet practised flight refuelling at night, and as further delay at London risked darkness at the point of the second refuelling, it was decided to fly to Iceland, land, refuel, and then proceed to Montreal, refuelling for the second time off Newfoundland. We left London Airport soon after 6 o'clock and landed at Keflavik; after refuelling we flew on a direct track over Goose Bay to Montreal. At the time the westerly interception was due to be made, we in the Liberator were flying in cloud at about 10,000ft, and dusk was creeping on. The tanker had taken off from Gander in very poor weather conditions, had climbed up through ice to about 12,000 feet and reported its position 25 or 30 miles behind. From that distance the closing speed would have been extremely slow, even had the Liberator been throttled right back, and the captain considered that, in the circumstances of poor visibility and approaching darkness, refuelling should be abandoned. The Liberator proceeded to Montreal, and the tanker, in the face of difficult weather, landed at Seven Islands, about 250 miles from base.

The problems of flight refuelling fall under three headings: economic, operational and psychological. The economic case has been put quite adequately by Flight Refuelling, Limited, and since no operator has disproved the claims for economy, it must be accepted until further proof is available, that the increase in payload more than compensates for the cost of operating tankers. When the present trials are completed it will be possible to assess the gain in payload which would have been achieved had the operations been commercial.

Operational

Captain J. Percy, line captain for the Atlantic Division of B.O.A.C., was made responsible for the North Atlantic flight-refuelling experiments. He has had vast flying experience particularly over the North Atlantic; and he personally made the first refuelling flight about three weeks ago. At Dorval I read the standing orders for the experimental unit and discussed with Captain Percy the organization behind the experiments. There can be no doubt that flight refuelling over the North Atlantic will be thoroughly tested and analysed by the Corporation; the scheme will be given a fair trial since it might conceivably lead to greater economy in the near or distant future. Safety, however, must be safeguarded, and that demands the utmost care in planning, and the system must be fully justified by economy in operation.

In order to obtain economy, the transport aircraft must refuel as near as possible to the opti-

ROY PEARL recently travelled as a passenger in the Liberator used as the "receiver" aircraft in the flight-refuelling trials now being made between this country and Canada.

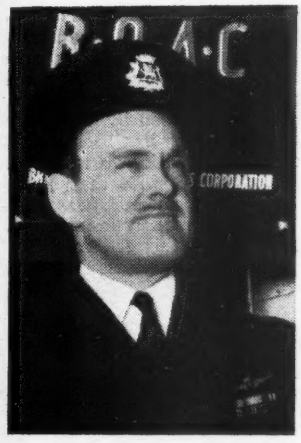
Here he records some of his impressions of the problems associated with this new method of combining long range with high payloads. In a subsequent article he will write of the interesting things he saw while he was in Canada.

mum refuelling position on its track, and that position is dependent upon the wind component. Refuelling at that position will permit the receiver to carry maximum payload without exceeding maximum gross weight at take-off or in the air. The flight plan requires two alternate airfields to be recommended on departure; at least one return alternative airfield must be available above the weather minima in addition to the departure point; and if the departure point is forecast below the limits after take-off, then a second return alternate must be designated.

The fuel calculations provide for an adequate amount to allow the aircraft to proceed from the designated terminal to the farthest terminal alternate, plus 25 per cent of the amount required from the terminal to the alternate airfield, plus one hour's fuel on arrival. For purposes of calculation the last 100 gals. (720 lb) of fuel are considered to be unusable, and in flight that amount would normally be deducted from the total weight of fuel remaining.

The flight plan for the refuelling tests is divided into four sections: 1, to the first refuelling position; 2, to return to base and alternates; 3, from the first refuelling position to the second refuelling position, with secondary destination and its alternatives; 4, from the second refuelling position to the final destination and alternates. Eastbound the aircraft would refuel in flight only once. The optimum position may be defined as the position at which the fuel required at point of departure to the refuelling point and return equals the fuel required from the first refuelling point to the second point plus the farthest alternates.

For maximum payload the first refuelling position is so calculated that the weight of fuel required for sections 1 and 2 of the flight plan may equal the weight of fuel required for section 3. Such an optimum position works out to be one-third of the air distance from the take-off to the farthest alternative in section 3 of the flight plan. It will thus be obvious that the optimum position will be closer to the point of departure with a tail wind and greater with a head wind.



Capt. J. Percy.

The amount of fuel would be calculated as follows: Section 1—fuel for first stage, plus 100 lb/hr, plus stand-off 900 lb; Section 2—from refuelling position to departure point, plus fuel to first alternate, plus 100 lb/hr fuel to farthest alternate, plus stand-off 900 lb, plus residual fuel 720 lb; Section 3—fuel for flying from the first refuelling point to the second refuelling point and a secondary destination, plus 100 lb/hr plus fuel to the farthest alternate, plus 25 per cent of fuel to the farthest alternate, plus 900 lb stand-off, plus 720 lb residual fuel; Section 4—from the refuelling point No. 2 to destination, plus 100 lb/hr, plus fuel to alternate, plus 25 per cent of fuel to alternate, plus 900 lb, plus 720 lb.

After a series of refuelling flights it will be possible to produce charts from which the optimum distance and the amount of fuel required may be easily and quickly read. The amount of flight planning, however, remains, and a last-minute change in the weather situation would entail a change of plan, requiring probably two hours of weather forecasting and flight planning.

It was suggested that on this fourth experimental flight the tanker could have intercepted off Iceland, but as the met. forecasting through Shannon is prolonged, the captain considered that more time could be saved by refuelling on the ground in Iceland; also, it was doubtful whether the Gander or Goose Lancasters would be able to fly owing to poor weather conditions at their bases. Flight planning is, therefore, a major problem in considering the possibilities of flight refuelling.

Operational considerations cannot be separated from economy, and flight refuelling is still in the early development stages; it is thus difficult, if not impossible, to asses its value. All operational factors must, however, be considered if absolute regularity is to be achieved. Although many test flights have been made with success in refuelling at night and in cloud, it is doubtful whether it can be one hundred per cent reliable, and for passenger air transportation there must be no greater risk in this operation than in a flight made without refuelling in the air.

The technique for refuelling in the air is capable of improvement. The aircraft refuel when in close company and in the wrong position. Many pilots do not like to have an aircraft formating closely whilst they are unable to see what is going on and therefore unable to take action in an emergency. At present the approximate distance between the two aircraft during the operation is about 100 feet, with the tanker above, to the side and slightly behind. The airline pilot hands over complete responsibility for his 30 or 40 passengers to the pilot of the tanker aircraft. That may seem an exaggerated viewpoint, but it could in fact be the situation with the present arrangement. and although flight refuelling pilots are skilled specialists at the present moment, the international scale of operation which would make this a practical and economic proposition would entail the recruiting and training of many more pilots.

Alternative Methods

Some hold the view that a better position for the tanker would be within view of the pilot, and a suggestion has been made that it should be stationed below and to the side of the receiver, with a pump for pressure refuelling in the tanker, and with both aircraft never nearer than 300 feet. It has also been seriously suggested that the receiver should tow the tanker. It would, perhaps, be possible for the tanker to take up a position directly behind the receiver, throttle back about one inch of boost, and then for the receiver to open up to maintain cruising speed. Although the tanker in this case would be out of sight of the receiver pilot, he would still be in control during the operation. Safety could be guarded by a manual release of the tow rope at both ends.

Modern aircraft can climb above bad weather in the North Atlantic, and it is obvious that, if refuelling is to be done regularly in complete safety, it must be done in clear air. The tanker must, therefore, be equally capable of climbing above the weather and having, at that height (20,000-25,000 feet) a sufficient reserve of power and adequate control to ensure safe manœuvrability. Tankers must in consequence be of modern and perhaps special design. That is the main reason why, in my view, the present experiments will prove little, since both the receiver and the tanker aircraft are unsuitable for regular flight refuelling.

I have already mentioned the crew's reaction to flying in close proximity to other aircraft. That will be disputed by some pilots in B.S.A.A., who were enthusiastic about the trials in the South Atlantic; but they were made in good weather conditions. Passenger reaction must also be considered, and I do not believe that the operation will be regarded with complete calm.

In conclusion, I am sure that the Ministry and Corporations are sufficiently interested to experiment further with this revolutionary method of obtaining long-range flying combined with heavy payloads. The aircraft are not yet available for giving it a fully convincing trial.

NOT IN CAMERA

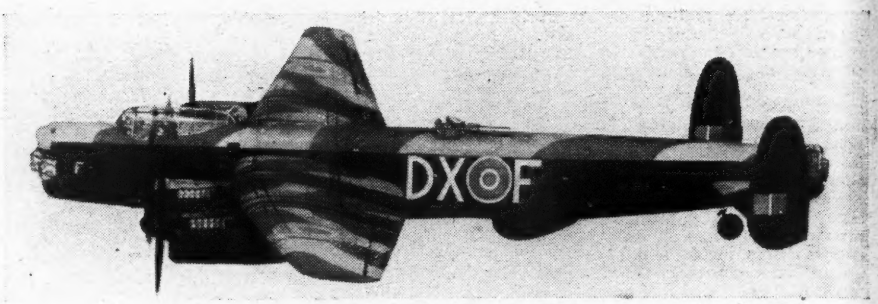
A FULL and pleasant evening was spent by employees of the Williamson Manufacturing Co., Ltd., and their guests at the Café Royal on February 21st.

Mr. Strachey's restrictive practices made impossible a formal dinner, but the buffet supper was a satisfying alternative and everyone, including the cabaret artists, seemed thoroughly to enjoy themselves, despite the forbidding weather outside.

The chairman of the company, Mr. C. M. Williamson, said that, although past the normal retiring age, he had no intention of retiring but intended to make provision for 1,750 shares in the company to be distributed among employees in strict order of length of service. Understandably, this announcement was received with considerable applause.

LYONS TRADE FAIR

THE Lyons International Trade Fair will open on April 3rd for nine days until April 12th. In the Palais des Nations Britain will be represented by B.E.A.C. The French Consulate are issuing passes to established business men and trade buyers will receive a free entry card valid for the duration of the fair. The fair authorities have made arrangements for hotel accommodation and transport in the nearby towns of Bourg and Aix-les-Bains. In the Grand Palais, Group 56 on the ground floor will be devoted to aviation exhibits. Catalogues will be ready in the middle of March and may be obtained, price 10s post free, through Clifford Martin. Ltd., Piccadilly House, 33, Lower Regent Street, W.1, from whom further information may be obtained.



Standard equipment in heavy-bomber units of the R.A.F.—the Avro Lincoln, with Rolls-Royce Merlin engines. Max. bomb load: 22,000 lb; armament: 4×0.5in and 2×20 mm guns.

"Flight" photograph.

BOMBERS of the POWERS

British, American and Russian Types: The Lincoln Our Latest: Brabazon-size Bombers in Production

IN a memorandum accompanying the Air Estimates for 1948-49, the Secretary for Air has stated that special attention is being given to the training of the R.A.F.'s Bomber Force in the realization that the existence of efficient striking forces is this country's most effective safeguard against aggression. He further remarked that the Air Council aims "to enable a substantial weight of air power to be developed at short notice in any area where it may be required." Thus the emphasis is on training, mobility and re-deployment. Re-equipment has no place in the programme.

The factors governing our present bomber policy are not difficult to perceive. Skilled manpower and money are in short supply, scales of equipment and re-equipment are proportionately low, and the metamorphosis which has become apparent in the design of all classes of high performance aircraft is of so radical a character that a vast amount of basic research must be undertaken before suitable new types of bomber can be introduced into service. Britain now possesses a small operational force of Lincolns and Lancasters, backed, it may be presumed, by fair stocks of wartime Lancasters and Halifaxes and manned by crews who, though well trained on standard equipment, lack experience of bombers with a higher performance than the Lincoln.

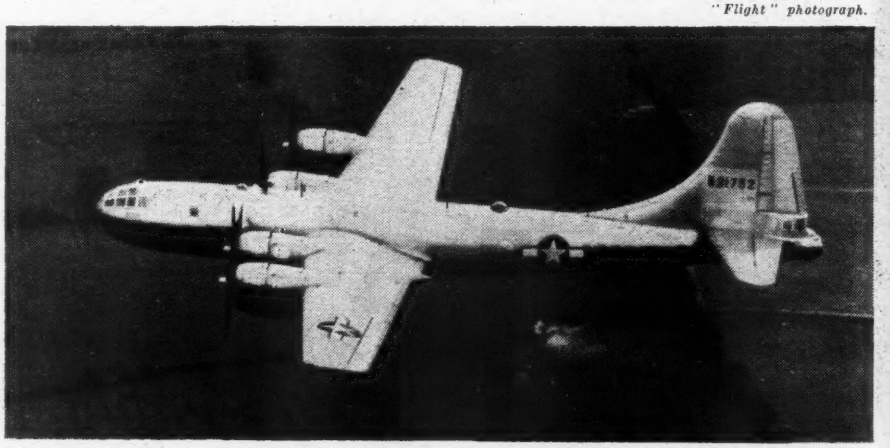
Though an admirable machine in many ways, the Lincoln, it must be remembered, is a development of the Lancaster and is itself five years old in design. Post-war improvements in the type have been of a relatively minor nature and no Mark is known to be capable of the performance of the contemporary American B-29 Superfortress—still less of the later B-50. It is, nevertheless, gratifying to record that the maximum bomb load of the Lincoln is 22,000 lb, and that when this is reduced to 3,000 lb a range of 4,450 miles is attainable by the standard Mark II version. The armament is four 0.5in guns and twin 20 mm guns in a dorsal turret. Though over 300 m.p.h., the top speed is appreciably lower than that of comparable American types.

The bomber situation in Britain would be less disturbing if service trials were known to be in progress on more modern types than the Lincoln, especially turbine-powered machines. Such, however, is far from being the case, though a measure of satisfaction is afforded by a Ministry of Supply announcement that an order has been placed for a medium-range bomber powered with two turbo-jets and capable of a speed approximately twice that of the Lincoln, and that, subsequent to this, an order was given for a heavy four-jet bomber with a similar performance, but having a longer range. Against this solitary statement must be set a mass of American releases concerning five new types of jet bomber for the U.S. Air Forces, all of which have flown.

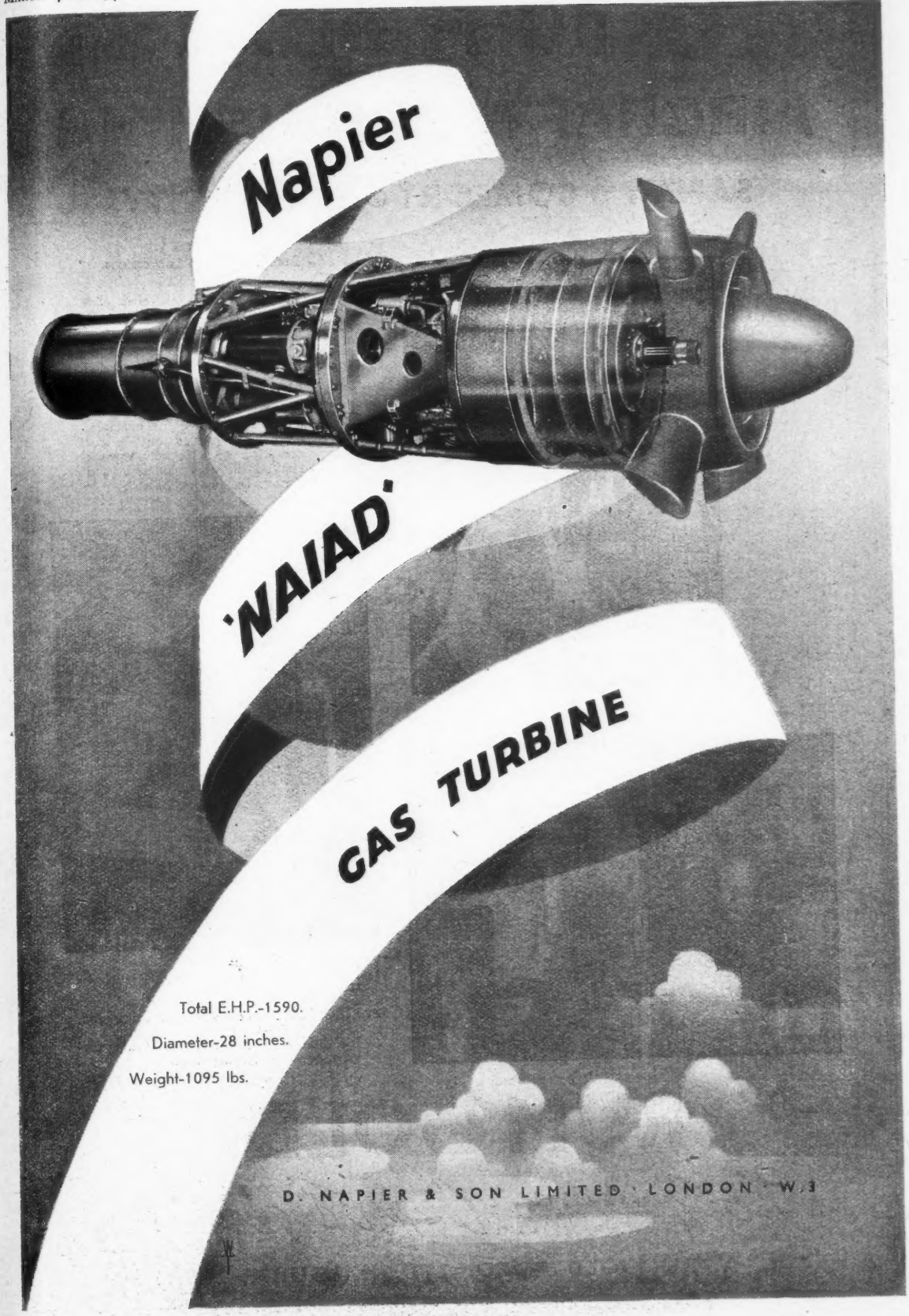
The Boeing B-50

For the present, the greater part of the American bomber force is composed of B-29s, large number of which have lately been taken out of store, but deliveries of B-50s will start in the spring. This latest model of the Superfortress (215 are on order) is claimed to cruise 27 per cent faster than the B-29 over equal ranges; cruise about 50 m.p.h. faster than any other bomber capable of flying equivalent distances; and to have a top speed approaching 400 m.p.h. Four 3,500 h.p. Wasp Major engines are fitted and a great deal of structure weight has been saved.

"Flight" photograph.



Pressurized for high-altitude operation the Boeing B-29 (Wright R-3350 engines) remains in service as a standard U.S. heavy bomber. Maximum armament is ten 0.5in guns and one 20 mm.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GAS TURBINE
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Diameter-28 inches.
Weight-1095 lbs.
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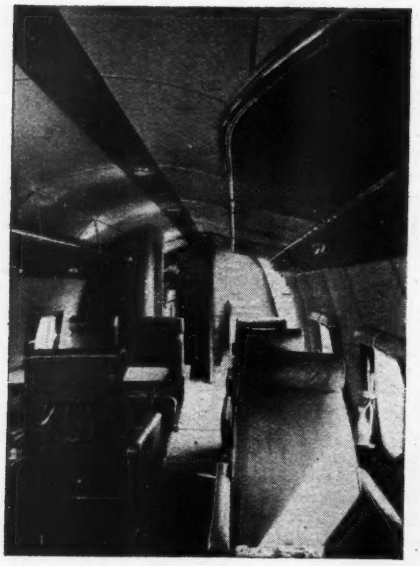
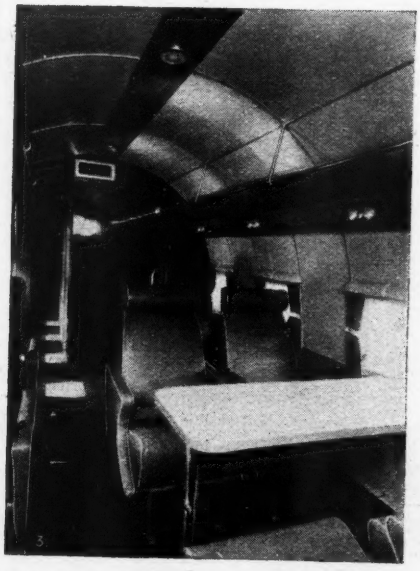


★ Rumbold Dakota Conversions.

★ Rumbold carry out civil conversions for all types of aircraft, British and American.

★ Rumbold conversions are carried out in co-operation with the leading aircraft maintenance and repair concerns.
Many conversions, for example, have been carried out in co-operation with Messrs. Airwork Limited in this country, and Messrs. Fokker in Holland.



1. RUMBOLD Executive model looking aft towards buffet and toilet.
2. RUMBOLD Standard 21-seater conversion.
3. RUMBOLD Executive model looking forward towards sleeping cabin.

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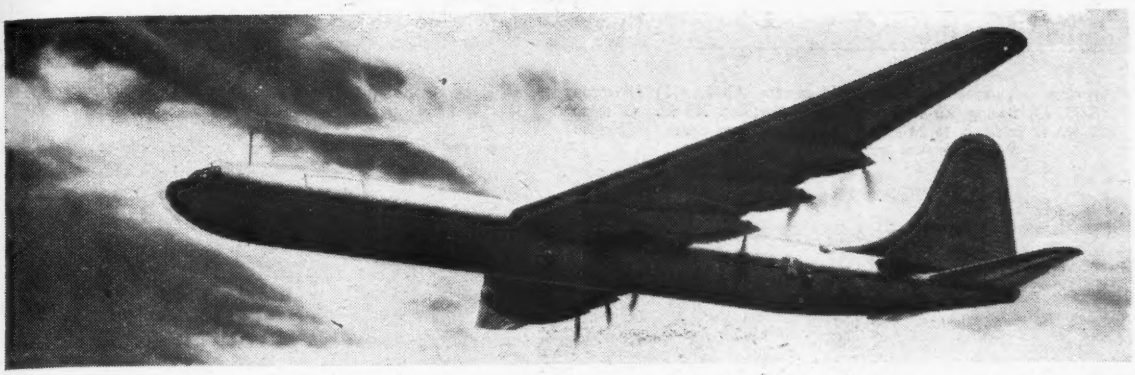
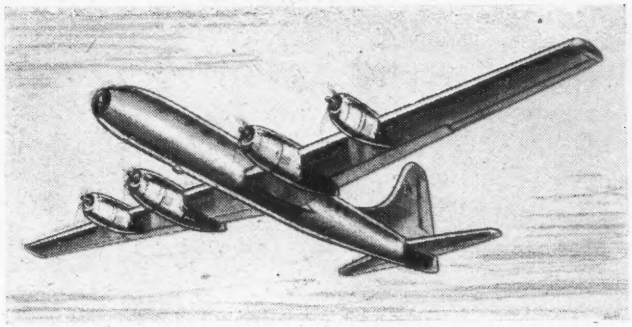


Capab'e of carrying 10,000 lb of bombs for 10,000 miles, or 72,000 lb for short range, the Convair B-36 (above) is the world's largest bomber. On the right is the Russian TU 70 transport which uses B-29 components and may have a bomber counterpart.



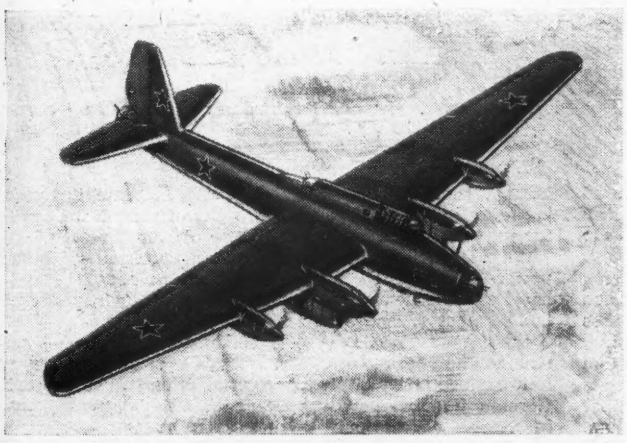
Bombers of the Powers . . . . .

It is not generally appreciated that a hundred bombers, each equivalent in size and weight to the Bristol Brabazon, are already in production at the Consolidated-Vultee plant. Designated B-36, the type concerned has six Wasp Major engines, weighs 139 tons, and is claimed to have a range of 10,000 miles, without extra tanks, when carrying 10,000 lb of bombs. For short range, a bomb load of 72,000 lb can be taken. A very large number of 20 mm guns will be installed and a small "parasite" fighter, to be carried by the B-36 for its own defence, is undergoing development.

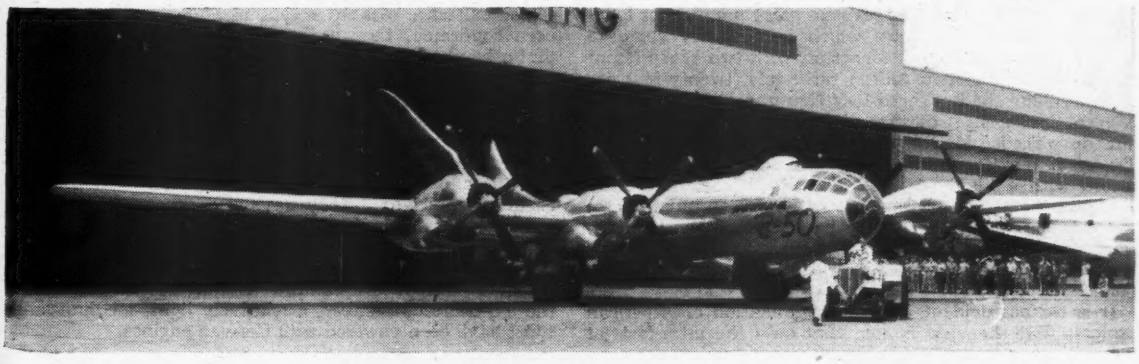
Apart from the B-50 and B-36, the only new American type of piston-engined bomber is the Northrop B-35 Flying Wing, of which thirteen only will be built. A version of this type—the XB-49—is already flying with eight turbo-jets in place of piston engines, but no announcement has been made of quantity production.

The first jet-propelled bomber to be ordered in quantity (at the moment 100) is the North American B-45A, with four General Electric J-35 turbo-jets. This is not a long-range type, but has a speed of over 480 m.p.h. Light armament is carried. Comparable with this North American machine is the Consolidated-Vultee XB-46, which may be the subject of a future production order. With the same power plant, due to its extremely fine lines, this type should be appreciably faster than the North American. A crew of three is carried and several months ago it was announced that the XB-46 had already attained maximum speed while flying at its designed gross weight of 91,000 lb.

A larger prototype is the six-jet Martin XB-48,

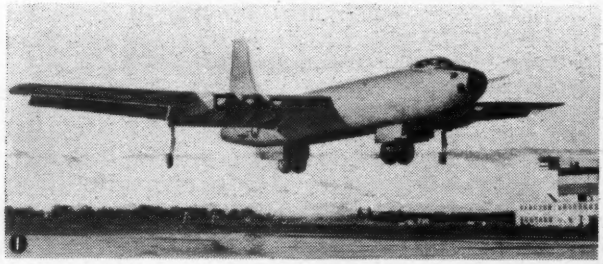


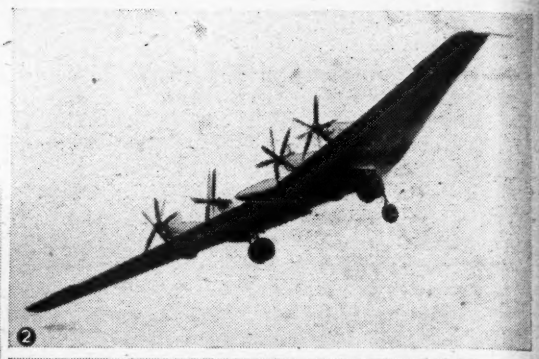
The TB-7, or PE-8 (left) has been a standard Soviet bomber for some years. Below is the American Boeing B-50, successor to the B-29.

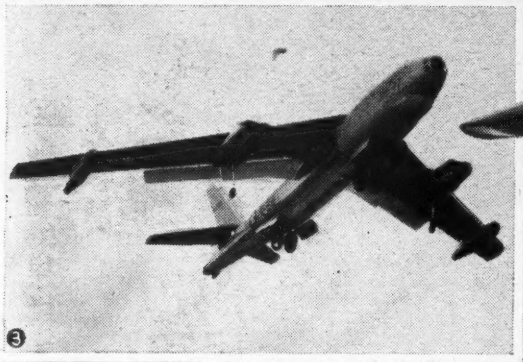


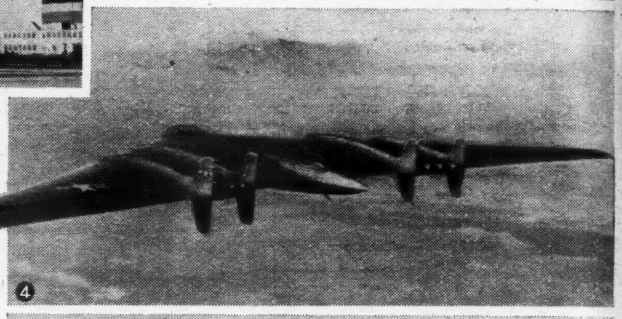
Bombers of the Powers . . . . .

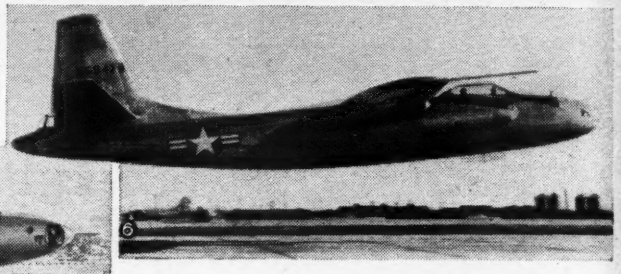
American high-speed bombers: (1) Martin XB-48, (2) Northrop XB-35, (3) Boeing XB-47 Stratojet, (4) Northrop XB-49. Of these the XB-47 is likely to be the subject of a large order. Thirteen B-35s are now under construction . . .











. . . Two more fast bombers: (5) Consolidated-Vultee XB-46 and (6) North-American B-45. A hundred of the latter type are on order.

stated to have "a tactical radius of over 800 miles and a speed of more than 480 m.p.h." Though slightly larger than a Lancaster, this machine weighs only 58,500 lb but has a bomb capacity of over 10 tons.

Least orthodox of the American bombers are the Boeing XB-47 Stratojet—a swept-wing, six-jet machine of 125,000 lb gross weight, designed to carry over 10 tons of bombs—and the Northrop XB-49 eight-jet Flying Wing, developed from the piston-engined B-35. No production order for either type has yet been announced, but there is reason to believe that the Boeing is considered "Number One" jet bomber in the U.S. Air Forces' programme.

Though not classed primarily as bombers, certain U.S. Navy "patrol bomber" types hold great promise for long-range attacks. Two types which immediately come to mind are the Martin P4M Mercator, with two Wasp Major piston engines and two Allison turbo-jets (twenty-four are on order), and the Lockheed P2V Neptune with two Wright R-3350 Cyclones. Contracts for over 130 Neptunes are already placed. It will be remembered that a P2V—the *Truculent Turtle*—is the holder of the world's distance record with a flight of 18,081.990 km. Like most other American bombers, the Neptune will carry an atom bomb.

From the foregoing, it will have been gathered that, while arming operational units with very-long-range piston-engined machines, America is pursuing an extensive jet-bomber development policy.

It is further evident from an examination of American projects that the view is held that only the ultra-fast jet bomber types can safely dispense with armament, and it is interesting to observe that on some of their fastest prototypes the Americans are making provision for guns.

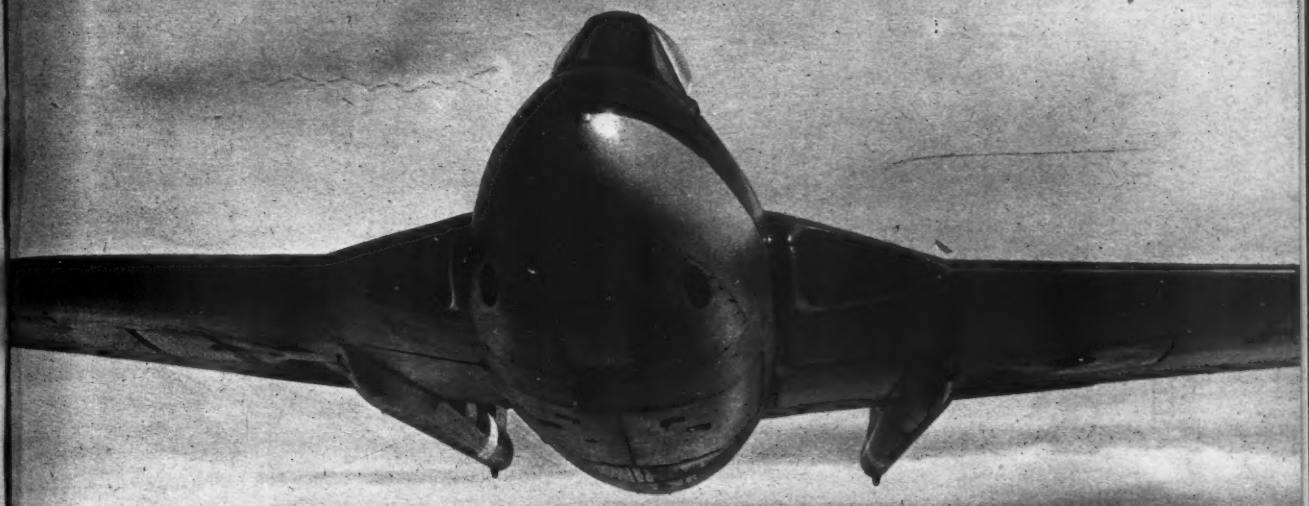
Consideration of the bomber forces possessed by other powers shows that France has a small number of Handley Page Halifaxes and that studies of high-speed jet bombers for *L'Armee de l'Air* are in hand.

Russia has never been notable for the efficiency of her strategic bomber force. Small quantities of TB-7 (or PE-8) four-engined bombers were operated during the war against German targets, including Berlin, and this type remains in service. With four AM-38 engines the range, with a two-ton bomb load, is probably less than 3,000 miles.

The existence of a later type of Soviet bomber has not been confirmed, though there is good reason to suppose that a bomber version of the TU-70 transport is under consideration or in being. The TU-70 incorporates major components of the B-29 Superfortress, but even in transport form far less efficient than the Stratocruiser.

It is important to remember, however, that Russian designers have had the benefit of German research data and facilities and a certain measure of co-operation from former enemy technicians. They have had access, for instance, to what remained of prototypes of the Ju 287 multi-jet bomber which, in one form, was intended to attain a maximum speed of 550 m.p.h. with a bomb load of 8,800 lb. There are indications that recent versions of the TU-2 attack bomber, a relatively light, medium-range type, have been powered with German engines.

INSTALLED EFFICIENCY



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★ Installed efficiency: The proportion of the thrust as measured under ideal conditions on the test-bed which is actually delivered to the aircraft in which the engine is installed

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A LEOPARD THAT DID . . .

Latest off the Tudor production line, this Mk IV, for British South American Airways, embodies recent modifications. The addition of short exhaust pipes to the inboard-side cylinder banks of the four Rolls-Royce Merlins has resulted in a much quieter cabin, and an aerodynamic clean-up has improved performance. This aircraft is at present at Boscombe and will, it is hoped, be in service very shortly.

RESEARCH FOR SPEED

Survey of Variable-Density High-Speed Tunnel at Royal Aircraft Establishment, Farnborough

A recent lecture to the Royal Aeronautical Society by Mr. W. G. A. Perring, director of the Royal Aircraft Establishment, Farnborough, dealt with the high-speed wind tunnel and its work. A summary of the lecture was published in our issue of January 8th. The present article is the result of visits by members of our staff to the R.A.E., and deals with certain aspects of the high-speed tunnel not covered by our summary of the R.Ae.S. lecture.

ALTHOUGH it can be said that the wind tunnel has been a common feature of aeronautical development work for so long that it has nominally ceased to rank very high as an object of particular interest, this is true only nominally and cannot justifiably be applied in any except the widest of general terms. Specifically, the sizes and types of wind tunnel vary enormously, and the most modern examples present a marked advance from the early concepts of such apparatus.

Further, whilst the majority of people with any aeronautical interest at all know very well what a wind tunnel is, relatively few can have any real appreciation of the complexity of a large tunnel, or of the elaboration of ancillary equipment involved. A large modern high-speed wind tunnel is not only a great piece of structural engineering, it is also a highly developed scientific instrument.

A fine example of this is the large tunnel at the Royal Aircraft Establishment, Farnborough. Proposals for the construction of a high-speed wind tunnel were considered early in 1937, and the detail design work was started at the Establishment in 1938. Construction began in 1939, and by 1942 the work was completed and the first tests started.

In order to facilitate an easy understanding of the tunnel layout, the fabric can be split into four main divisions; centrally there is the tunnel room, housing the tunnel itself, and at the east end of this is the motor room in which are the generators and fan-driving motors. At the west end of the tunnel is a large room accommodating the refrigerating plant and the air compressors/evacuators, whilst on the south side is the office block with, above it, the nerve centre of the whole body, the control room. Between the offices and the tunnel at ground level is the model room, complete with lift whereby the models are carried up to the control room and thence into the tunnel.

The tunnel room is lined throughout with a 5in thick layer of cork for heat insulation and this, incidentally, provides such effective sound proofing that no obtrusive noise is transmitted to the offices, even when the tunnel is being run at its maximum speed.

Perhaps the best way in which to visualize the tunnel structure proper is that it comprises a huge steel cylinder 37ft in diameter and 130ft long with hemispherical ends enclosing a further double-walled cylinder housed co-axially within it. The outer steel shell of the tunnel is designed to withstand internal absolute pressures ranging from 0.1 to 4 atmospheres. Most of the walls are of $\frac{3}{8}$in steel plate, but the outer shell is $\frac{5}{16}$in thick and the working section is fabricated of machined cast iron to ensure accuracy.

The internal cylinder tapers slightly from end to end on its outer diameters, whilst the "core passage" formed by the inner wall has a bell mouth at the entry which converges in a 7:1 ratio and, at the same time, also changes its cross-sectional shape from circular to rectangular. The rectangular trunk, which comprises the working section, has an axial length of 15ft and is 10ft wide by 7ft high at the entry station: this height increases uniformly to 7ft 2in at the downstream end, so giving an expansion of $2\frac{1}{2}$ per cent to compensate for increase in boundary layer thickness. The air circuit is vented to the dead air space (i.e., the annular space between the walls of the inner cylinder) through thirty-eight $2\frac{1}{2}$in diameter holes around the downstream end of the working section. Between the latter and the fan, the sectional shape changes from rectangular back to circular, whilst the linear form is divergent, the area of the passage being doubled.

The fan is a 16ft-diameter, 13-blade unit mounted on a spinner-type fairing with swirl vanes on its up- and down-stream sides. Rotation is left-hand and the normal maximum speed is 850 r.p.m., although the fan was originally designed for a higher speed. The fan is driven by two direct-current motors of 2,000 h.p. each, mounted in tandem on a common shaft and operating in a speed range of 320 to 960 r.p.m. Flexibility is introduced into

the drive by the inclusion of a Bibby coupling at each end of the shaft, to compensate for distortion or movement of the tunnel structure under the influence of pressure and temperature changes.

An oil seal to prevent leakage when the tunnel is under pressure or vacuum is provided where the shaft pierces the tunnel shell; the oil pressure is adjusted automatically as the air pressure in the tunnel is changed.

Power supply is taken from the national grid and is fed through a 7,500 kVA transformer to bring the voltage to 6,600 prior to being delivered to a 4,800 h.p. synchronous induction A.C. motor. The latter is mounted on the same shaft as, and between, a pair of 1,620 kW, 525-volt D.C. generators. The A.C. motor, of course, drives the generators, which in turn provide the power for driving the fan motors. Smaller generators are fitted (one at each end) on the same shaft as the main generator, one for powering the auxiliary services whilst the other is an exciter for the A.C. motor.

Fan speed is controlled from the observation room by the Ward Leonard system. In order to keep the speed steady, an automatic control is used in which the voltage from a tachometer/generator on the fan shaft is compared with a pre-set standard voltage, the difference then being amplified and fed to an auxiliary field on the main generator.

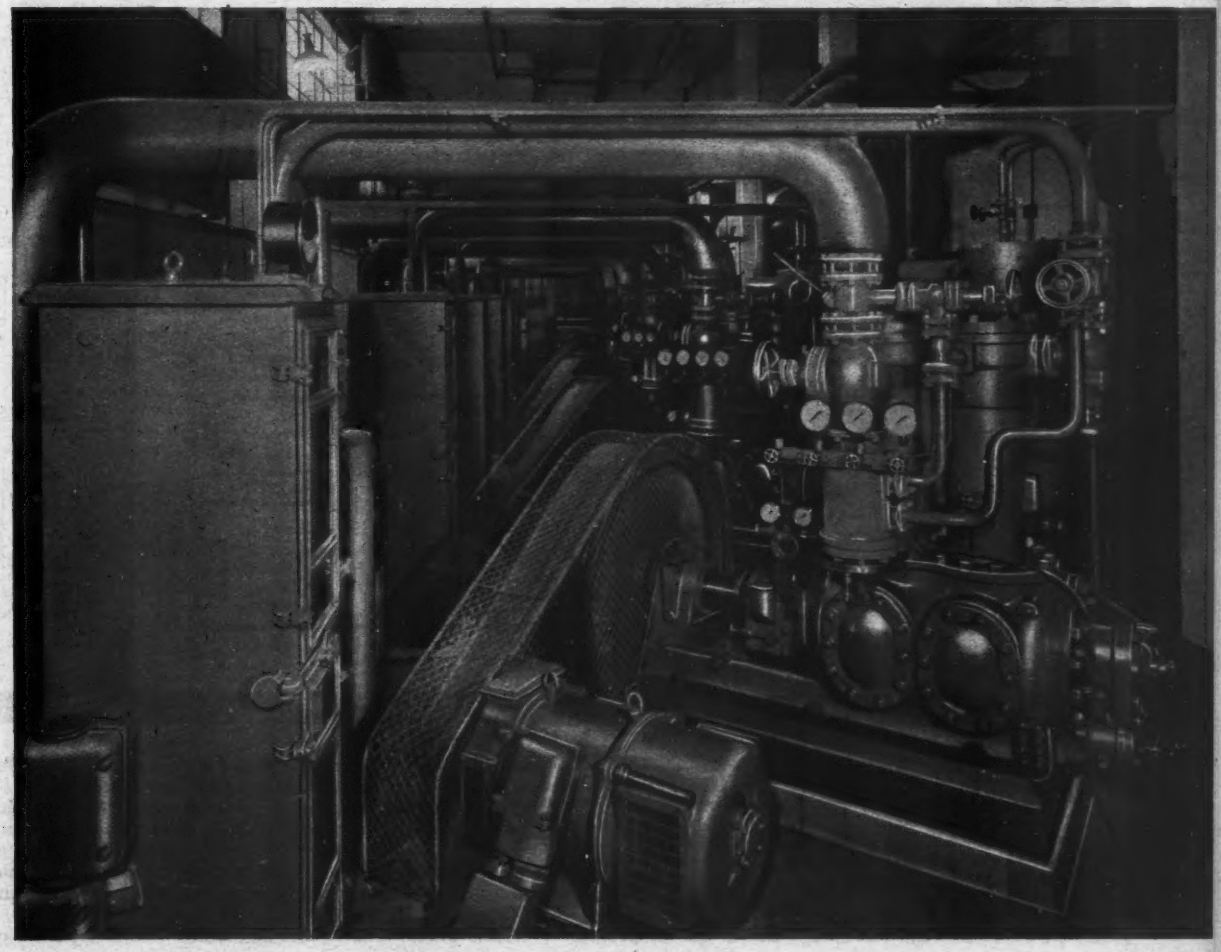
As the tunnel is of variable-density type and confines a high-speed circulation of so viscous a fluid as air, which entails considerable temperature rise through friction, large plants are required for compressing air in the tunnel, or evacuating it, and for cooling the tunnel walls.

Variation in density is afforded by dual 400 h.p. compressor/evacuators which can pump up the tunnel to an absolute pressure of 4 atmospheres in about 80 minutes, or evacuate down to $\frac{1}{10}$th of an atmosphere in about 45 minutes. When the desired conditions are achieved, the main units are cut out and their function taken over by an 80 h.p. control unit, which is kept running the whole time and, via a by-pass or spill valve, compensates for leakage in the tunnel structure and so maintains the required conditions. All three units are piston-type pumps.

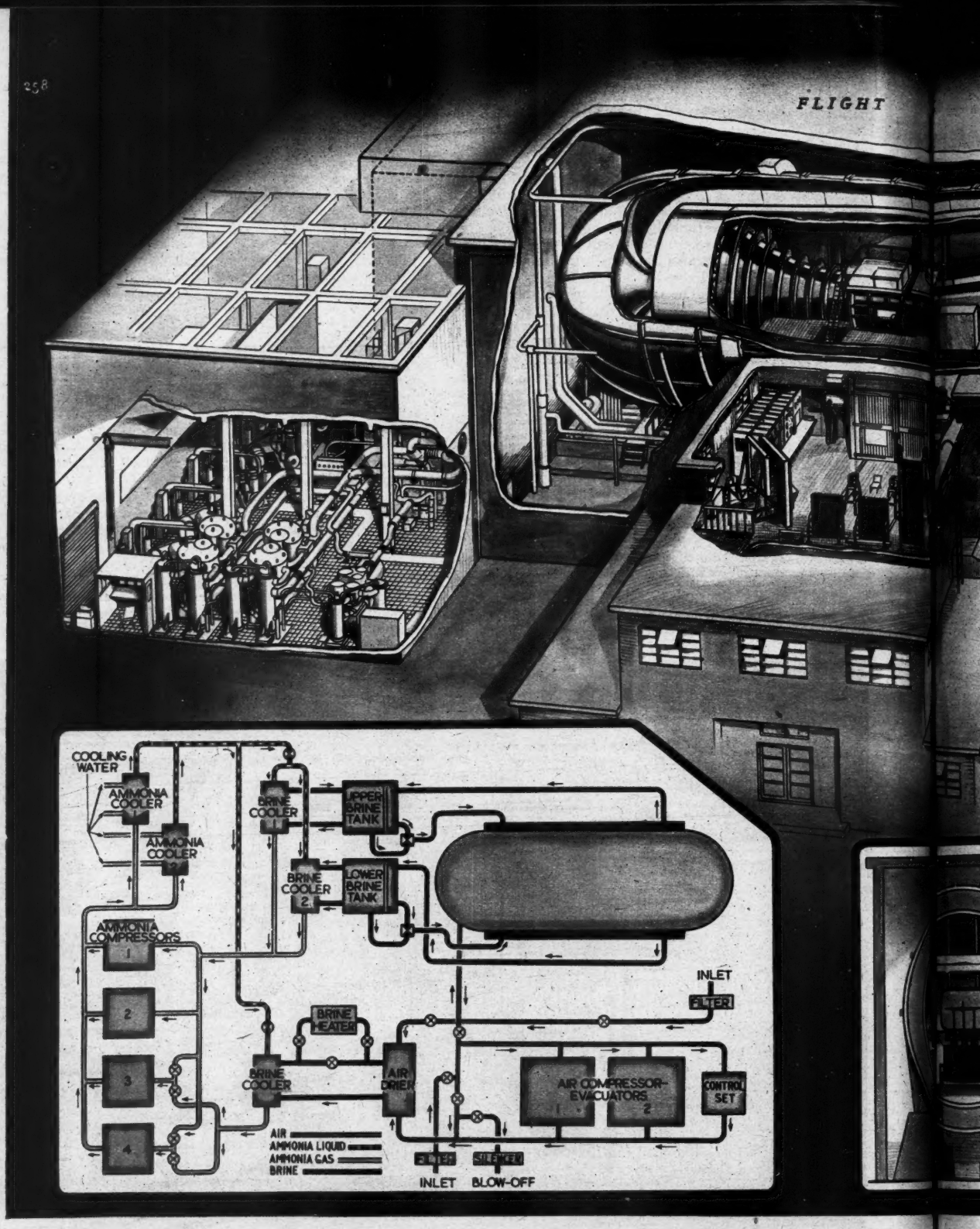
Coolant in Tons

The refrigeration plant comprises four two-stage ammonia compressors of normal commercial type; these are employed to cool the brine which is circulated through jackets on the tunnel walls. At full load the 4,000 h.p. supplied to the fan has to be removed from the tunnel in the form of heat and, as the refrigerating machinery cannot handle this continuously, low-temperature reservoirs are provided in the form of two huge tanks, one for each of the upper and lower sets of tunnel jackets.

Each tank holds 230 tons (42,000 gallons), and each upper and lower jacket capacity is an additional 77 tons. The brine is a calcium chloride/water composition with a percentage of sodium dichromate added as an inhibitor; it is kept at a specific density of 1.23 and the circulation rate is approximately 2,360 gall/min for each tank and jacket. Both the main brine storage tanks are kept at a temperature of −12 deg C, and it has been established in practice that a brine circulation temperature around the



This phalanx of ammonia compressors is clearly indicative of the immaculate state in which the whole of the equipment is maintained.



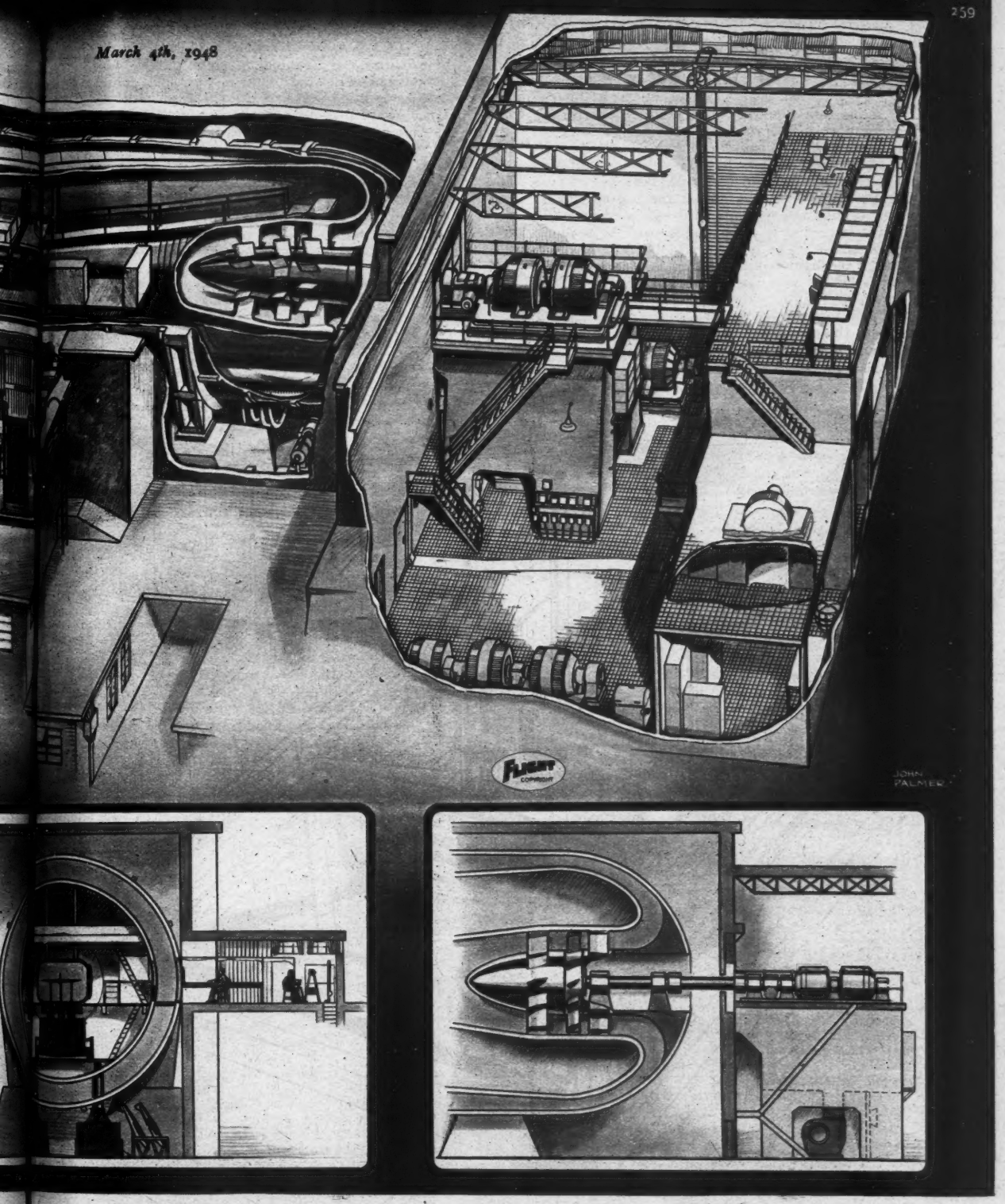
RESEARCH FOR SPEED . . .

Layout of the tunnel buildings looking North and showing the motor room at the East end, the control room over the offices, and the refrigeration and compressor/evacuator plant at the West end. The arrangement of the latter and the flow circuits is shown at lower left, and in the centre and at right are respectively sections through the working section and the control room and through the fan and motor drive.

tunnel of + 4 deg C is adequate for all normal work; this can, however, be reduced if necessary to −10 deg C.

From the main tanks the brine is sucked to a battery of three pumps, and a thermostatic device in the delivery line from these brings a mixing valve into operation as required, whereby cold brine from the main body of the tank is introduced to mix with the warm brine being circulated.

These pumps deliver into the tunnel jackets from which



the return flow is directed into a partitioned corner of each tank divided from the main capacity by a weir. Cold brine for admixture is taken from the main body of the tank, and this abstraction is compensated by a proportion of the returned brine flowing over the weir into the cold brine. The latter is kept cold by the ammonia refrigeration plant, and the flow sequence is from tank through a heat exchanger (one for each tank) and back at a rate of 350 gall/min. The cooling is achieved by the ammonia absorbing the latent heat from the brine and giving it up to water, which is expended, with a consequent drop in temperature of the brine. The capacity of the cooling plant is 30,000,000 B.Th.U. per 24 hours, which represents the cooling required for about three hours' continuous tunnel-running at full load.

Air admitted to the tunnel, including the constant delivery of leak-compensating air, is dried after leaving the compressors, by circulation through three brine coolers in

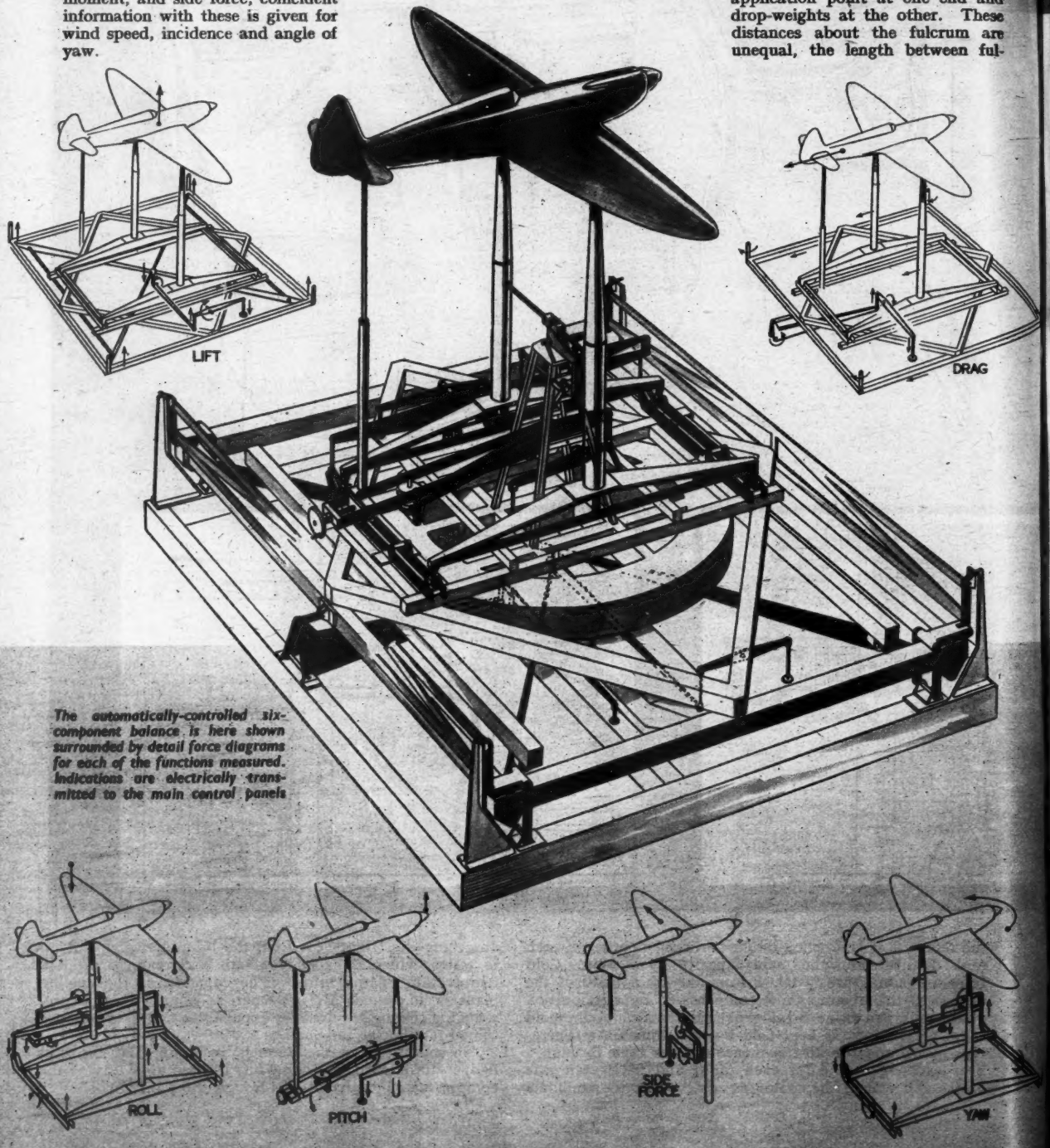
RESEARCH FOR SPEED . . .

the form of simple tube-type heat exchangers. The air is dried by dropping its temperature to −18 deg C and condensing-out most of the moisture. The cooling capacity is 4,000 cu ft/min, and relative humidity in the dead air space in the tunnel is of the order of 7 per cent.

Measurements of the forces acting on the test specimen in the working section are registered through a compound balance, located immediately beneath the working section in the dead air space. The balance is a beautifully constructed piece of mechanism and is of R.A.E. design, the six components which can be measured being, respectively, lift, drag, pitching moment, rolling moment, yawing moment, and side force; coincident information with these is given for wind speed, incidence and angle of yaw.

The whole balance is mounted on eight pillars, which are clear of the tunnel structure and rest on solid foundations. In order to minimize errors of distortion, all parts of the balance are of massive construction, and the design is such that the distortion which does occur will produce negligible errors. Instead of moving-pivots or knife-edges, flexible steel connections of various kinds are employed. These include single flat strips for taking direct tension, two crossed flat strips for cross loads, or where a definite centre is required, and circular-section wires where freedom in two directions is needed. This arrangement eliminates all sliding frictions, the small necessary deformations occurring elastically.

The balance element for each component incorporates a steelyard, pivoted on spring centres, with the force application point at one end and drop-weights at the other. These distances about the fulcrum are unequal, the length between ful-



The automatically-controlled six-component balance is here shown surrounded by detail force diagrams for each of the functions measured. Indications are electrically transmitted to the main control panels

These views " outside " and " inside " show respectively the maze of brine-conducting pipes and the jacketing to the diffuser section as seen in the dead-air space, and the working section viewed from just ahead of the fan, showing the mounting turntable, lamps, vent-holes and windows.

crum and drop-weights being very much the greater. Lever linkages connect the model and the force application point, and a motor-driven leadscrew drives a jockeyweight, or rider, along the steelyard which, in conjunction with the drop-weights, balances-out the applied force. A selsyn unit indicates the obtaining position of the rider (and a similar selsyn does the same for the drop-weights), and the receiving ends of the selsyn are linked direct to the appropriate indicators on the control panel.

The drop-weights are put on or taken off as required by forked levers, actuated by cam-rings driven by motors controlled from the panel. Thus any combination of weights for a given condition can be selected and the rider used to obtain balance. As an illustration, for a given incidence and air speed, the drag, lift, and pitching moment will be a, b, and c. If the incidence is changed but the air speed kept constant, different values of a, b, and c will be indicated and, when the dials have stabilized, i.e., when the three values are corrected for the new condition, the dials are photographed by standard R.A.F. pattern F.24 cameras fitted behind the control panel.

Speed Measurement

The six weighbeams of the balance are complemented by a seventh weighbeam which is used for a manometric balance. This latter device measures the pressure differential between the settling chamber and the working section and is calibrated to indicate the wind speed. Two cast-iron mercury-pots with a connecting pipe are mounted at the ends of the weighbeam; any pressure difference displaces the mercury and so produces a load on the weighbeam which is then balanced-out by a rider and drop-weights in the usual way. The dials on the panel are arranged to register the pressure difference in inches of water.

The ranges and sensitivities of the balance are as follows:—

Lift	−100 lb to 1,200 lb by 0.1 lb
Drag	−150 lb to 300 lb by 0.01 lb
Pitching moment..	−500 lb ft to 500 lb ft by 0.1 lb ft
Rolling moment ..	−400 lb ft to 400 lb ft by 0.2 lb ft
Yawing moment ..	−500 lb ft to 500 lb ft by 0.25 lb ft
Side force	−400 lb to 400 lb by 0.2 lb
Wind speed	zero to 80in H_2O by 0.01in

Although wind speed is given by the manometric balance, the absolute pressure in the working section must also be known in order to derive the Mach number. This is obtained by a special barometer, for pressures below atmospheric, which embraces a range down to 2in Hg absolute and can be read to 0.01in: for pressures above atmospheric, a Bourdon-type pressure gauge is employed.

For such measurements as the pressure distribution over an aerofoil, or the total head across a wake, multi-tube manometers are used. About a hundred copper pipes are permanently connected from the manometers in the control room to a distribution board inside the tunnel, from which they can be connected to the specimen in the working section as required. The manometer readings are recorded photographically, the distances of the cameras being altered according to the range and accuracy required. A projector is used for reading the films.

It is occasionally necessary to measure the humidity of the air in the tunnel, and this is done with a specially devised hygrometer. Air from the tunnel is drawn over a polished steel mirror which can be cooled by liquid oxygen. An optical system throws an image of a small filament on to this mirror, the image being invisible when the mirror is clean but appearing when a deposit of hoar frost is formed. The dewpoint of the air is measured by cooling the mirror gradually and observing the temperature at which the image becomes visible.

The reduction of the balance readings to coefficient form is laborious, partly because of the large number of readings and partly because the value of $\frac{1}{2}\rho V^2$ depends both on the Mach number and tunnel pressure, and it is not practicable to keep both of these exactly constant during a run.

The first stage in the calculation, after reading the films, is to obtain the Mach number M from the wind-speed reading p_1-p_2 and the tunnel pressure p_2 for each exposure. The value of $\frac{1}{2}\rho V^2$ is obtained by multiplying p_1-p_2 by a factor which is a nearly constant function of M, and the coefficients C_L, C_D, and C_m are computed. Next, since the Mach number is not exactly the same at each incidence, each coefficient must be plotted against M at constant incidence and interpolated values obtained for a selected value of M. Finally, various corrections have to be applied. Electric calculating machines are used for most of the arithmetical operations, and the computing is done to four significant figures, the final results being given to three. The analysis of a day's running in the tunnel will occupy two computers for about a week.

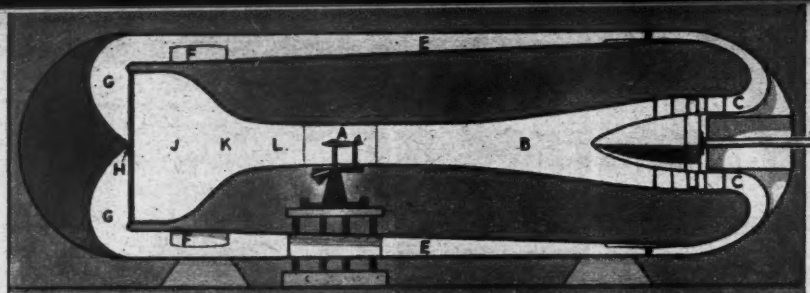
Co-operative Effort

A tunnel of this size and complexity involves the co-operation of many workers of different kinds. First, a test has to be planned, then a model must be designed, drawn and made. The model must then be rigged in the tunnel, the fan must be run, the pressure adjusted, and the cooling plant kept working while the measurements are taken. The photographic records must be developed and read, the results computed and curves plotted. Finally, the test results must be examined and digested and described in a written report. A failure at any point in this chain of operations would make the whole test useless.

The staff of the tunnel is comprised as follows:—

Technical and scientific staff	16
Assistants (chiefly computers)	18
Designer and draughtsmen	9
Wood and metal workers	15
Fitters and riggers	5
Compressor and refrigeration staff	9
Electricians	3

The proportions of the different kinds of staff must be carefully balanced to keep the tunnel working satisfactorily at its full capacity. The ultimate limitation of output is in the cooling plant, which cannot be run for more than 24 hours a day, so that the tunnel cannot be used more than 12 hours, including rigging time. This limit was not



Mach. No. : 0.8 Reynolds No. : 1 million per ft chord. Air Temperature in tunnel (static) 30°C

Station	True Airspeed, m.p.h.	Air Temperature, °C	Air Static Pressure, lb/sq in	Air Density, slugs/cu ft	Relative air Density* $\rho : \rho_0$
A	590	— 5	2.3	0.00041	0.17
B	470	+ 9	2.75	0.000455	0.19
C	235	+24	3.35	0.000525	0.22
D	200	26	3.4	0.00053	0.225
E	90	29	3.5	0.000545	0.23
F	60	30	3.55	0.000545	0.23
G	60	30	3.55	0.00055	0.23
H	65	30	3.5	0.000545	0.22
J	65	30	3.5	0.000545	0.23
K	185	27	3.4	0.000535	0.225
L	505	4	2.6	0.00044	0.185

* Relative to ICAN sea level density (ρ_0)

Tabulation of the tunnel atmospheric conditions obtaining at various stations around the airflow circuit for a typical representative high-speed run.

RESEARCH FOR SPEED . . .

quite reached during the war, but any increase in running time would have required more wood workers to keep the tunnel supplied with models, and more computers to work out the results. An increase in the output of test data would have involved the further limitation, more insidious because less obvious, that the scientific staff would not have had time to give full consideration to the meaning and significance of the results.

Operating Limitations

The work of the Farnborough high-speed tunnel has been concerned chiefly with subsonic Mach numbers up to about 0.8. It is expected that much higher Mach numbers will commonly be reached in flight during the next few years, and thus there is now an urgent need for wind tunnel research at transonic and supersonic speeds. There is no serious difficulty in designing and using a supersonic tunnel for tests on models at Mach numbers above about 1.15 or 1.2. There are at present several of these tunnels in use at the National Physical Laboratory, but the largest have working sections only about 12in wide, and these are too small for satisfactory tests on complete models of aircraft. Several larger supersonic tunnels are now being designed, however, and it is hoped that these will be running in a few years' time.

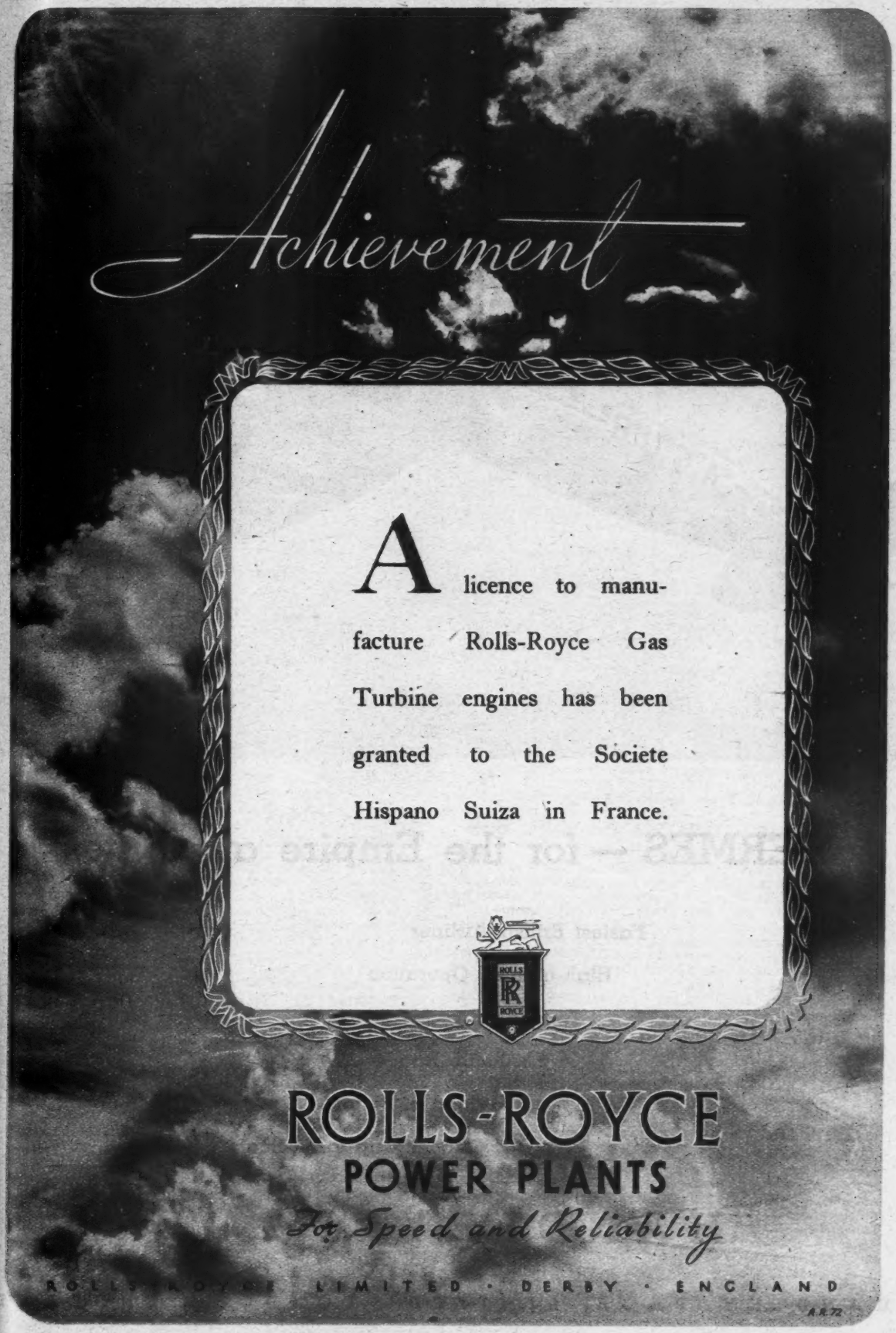
Tunnel tests at Mach numbers either below about 0.85 or above about 1.15 can be made without any very serious difficulties. On the other hand, tests at Mach numbers in the intermediate range involve very great difficulties which become more serious as the speed of sound is approached. At Mach numbers near unity, the effects of tunnel wall interference become very uncertain. In addition, the phenomenon of "choking" imposes an upper limit of Mach number in a subsonic tunnel and, equally, imposes a lower limit in a supersonic tunnel. These effects can be minimized by using very small models, but, unfortunately the problems of support interference become more serious. In small subsonic tunnels, used for tests on two-dimensional aerofoils, adjustable walls have sometimes been used to increase the choking speed, but these do not help to reduce the uncertainty of the wall interference effects at Mach numbers near unity.

In addition to these difficulties, there is another limitation which applies to all tests on complete models in high-speed tunnels, both subsonic or supersonic. Because of the necessity of keeping the model supports fairly small in order to avoid large interference effects at high Mach numbers, there is in practice an upper limit to the pressure that can be used in the tunnel. This means that for a given size of tunnel there is an upper limit to the Reynolds number at which the high-speed tests can be made, and Reynolds numbers approaching full-scale values can be reached only by using a very large tunnel. For a subsonic tunnel with a 16ft by 12ft working section, the maximum possible Reynolds number would probably be about 7×10^6 at a Mach number of 0.8. For these conditions, the power required would probably be about 50,000 h.p., and for any larger tunnel the power and cost would be almost prohibitive. The Reynolds number of even a small aircraft flying at a Mach number of 0.8 at a low altitude is about 40×10^6 which is much greater than the highest Reynolds number which is practicable for a tunnel test at this Mach number. However, by using a model of only 30in span (i.e., under half the usual size), and supporting it on a tail-sting in place of the normal struts, it has been possible to achieve a Reynolds number of 5×10^6 in the R.A.E. tunnel.

Additionally, the use of redesigned corner fillets in the working section has enabled models to be tested at Farnborough over a range of Mach numbers up to a limit of 0.94, and by refinement of the fillets it is hoped that a value of 0.96 may be achieved. Further work on the fillets is planned so that the tunnel may be run supersonically and tests made on a descending scale to approach sonic speed from velocities above a Mach value of unity.

From the foregoing it is clear that there are several important limitations in the use of high-speed tunnels, especially at speeds near that of sound. For general aeronautical research, at Mach numbers between 0.85 and 1.15, wind tunnels cannot well be used satisfactorily, and experiments must be made by moving aircraft or models through stationary air. The conventional form of flight research using a full-size piloted aircraft is one form of such experiment. Other forms which have been suggested are the use of models dropped from aircraft at high altitude, rocket-powered models launched from aircraft or from the ground, and rocket-powered models running along rail tracks.

Batteries of multi-tube manometers in the control room. Note the recording cameras and, at left, the massive door on its trolley and railway which is peripherally bolted-up and seals the tunnel casing.


Achievement
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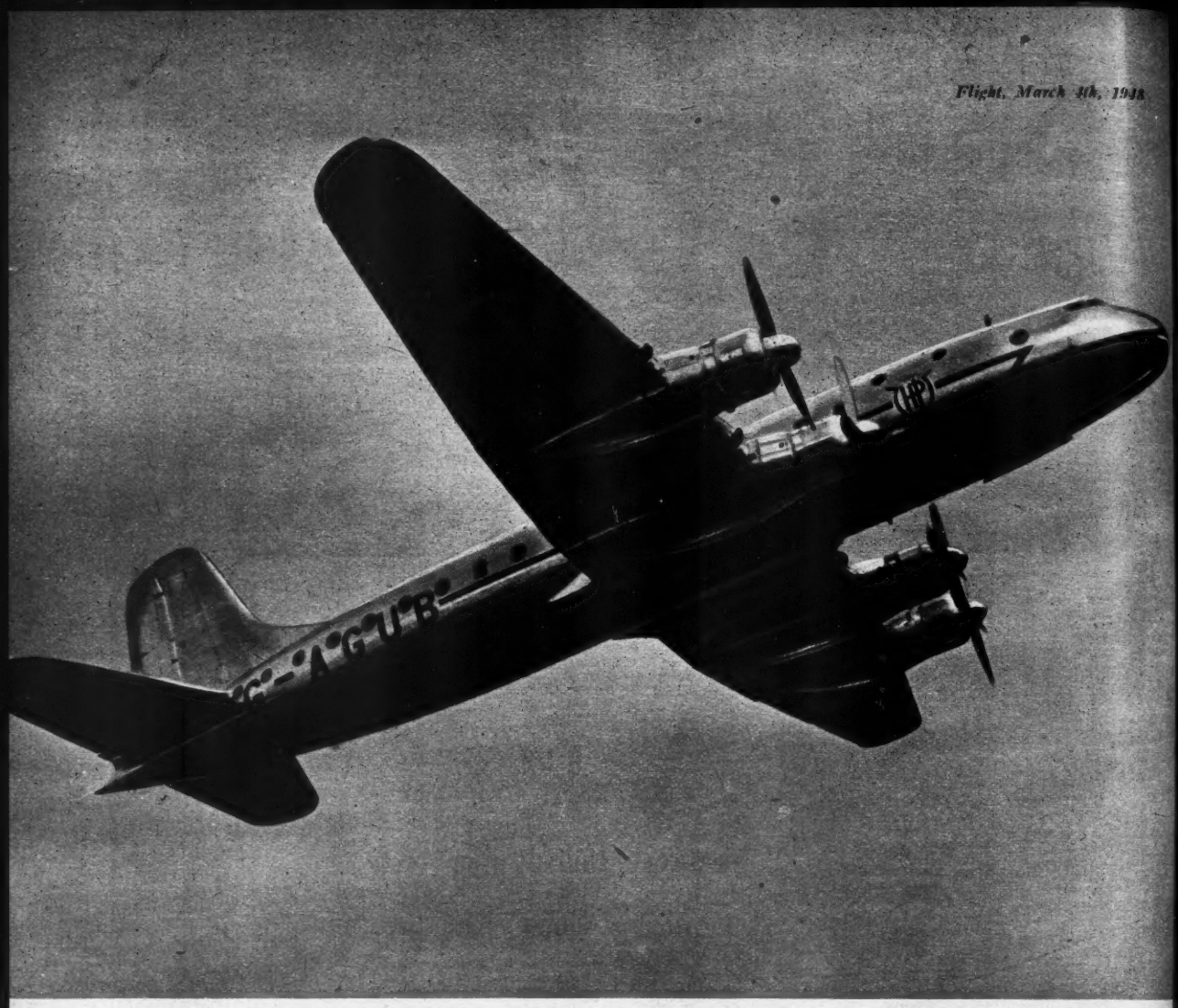

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CIVIL AVIATION NEWS

FEATHERED DOVE : One of the four D.H. Doves which have been ordered for Airways (India) Ltd., undergoing single engine flight trials over the de Havilland airfield at Hatfield. The compensating application of starboard rudder can be discerned.

I.A.T.A. Transactions : Caribbean Agreement : U.K. Traffic in December : Constitution Undercarriage

DOVES FOR ARGENTINA

A CONTRACT for 50 de Havilland Doves for the use of the Argentine Government has been received by the de Havilland Aircraft Company. This order, which follows an earlier one in 1946 for the supply of 20 Doves, includes quantities of spares, and will contribute nearly £2,000,000 to British export revenue. Many of the aircraft supplied under the original contract are giving good service in the Argentine and a repeat order for this type is encouraging. Amongst passenger and other duties a number of the Doves, equipped with de Havilland engines and airscrews, will be fitted with special equipment for combating locust plagues.

S.A.S. FAR EAST ROUTE

UNDER the terms of an agreement announced jointly between Scandinavian Airlines System and Northwest Airlines, a service offering a new route to the Far East via Alaska is to be available immediately. This new route will cut the time from Stockholm to Tokyo to 80 hours—30 hours less than for flights through the Mediterranean area. Mr. K. D. McKenzie, N.W.A. director of sales, has been appointed to the position of European director at the Northwest Airlines' office in London. He will work with S.A.S. officials on matters relating to the joint operations. Northwest Airlines aircraft will connect with the S.A.S. transatlantic flights at La Guardia airfield. The fares to be charged will be $445.15 from Minneapolis to St. Paul, $1,181.15 between Oslo and Tokyo, $1,274.15 from Stockholm to Manila, and $1,174.15 from Glasgow to Shanghai.

I.A.T.A. CAIRO CONFERENCE

AN international airline rate structure covering the services of airlines in Europe, Africa, and the Middle East, has been completed by the I.A.T.A. Traffic Conference No. 2 which followed a two weeks' meeting at Cairo recently. Subject to the approval of the interested governments, it is proposed to reduce rates within the Middle East region during the coming six months. However, due to rising costs in Europe, the Conference recommended slight increases in European passenger fares while maintaining European freight rates at their present levels. The Conference agreed that summer schedules, particularly from Europe to the Middle East, should be intensified.

International transactions handled through the I.A.T.A. Clearing House during 1947 totalled $52,400,000. It is claimed that the Clearing House procedure saved its members during 1947 more than three times the annual cost of operating the institution. Airlines who sell transport on each others' lines involving various currencies use the Clearing House to offset their respective monthly balances after the conversion either to sterling or to dollars. The settlement of all inter-airline transactions is thus reduced to a single payment to or from the Clearing House in one or the other currency. By thus reducing the bulk amount on which exchange premiums must be paid, members saved between $20,000 and $30,000. Protection from losses which would have followed the recent devaluation of the French franc has saved 24 members a total of $132,000, since December franc transactions amounting to $296,000 were reduced by the offsetting process to $157,232, which balance was then settled in £ and $ at the old rate of the franc.

SWEDISH AIRLINES STRIKE

ALL A.B.A. Swedish Airlines personnel in the Swedish Transport Workers' Union, who have been on strike since November 28th, 1947, involving a total of 1,200 workshop personnel, porters, drivers and stewards, have resisted the efforts of the government, the Central Committee of the Trade Union, and the Swedish Employers' Association to end the strike. In order to check the inflationary tendency in Sweden the government arbitration committee appealed to the workers to moderate their demands for increased wages. These would have meant an excessive cost of 4.7 million Swedish crowns per year, i.e., 64 per cent increase compared with 1947. The workers agreed to reduce their demands to 3.1 million crowns, and A.B.A.'s board of directors declared themselves willing to grant increases equivalent to approximately 1 million crowns, but this offer was rejected by the workers. A.B.A., who are anxious to make civil aviation in Sweden pay its own way, found it impossible to yield further since in so doing it would have been necessary to ask for a State subsidy.

WEST INDIAN AIRPORTS AGREEMENT

THE final agreement governing the regular use by civil aircraft of Kindley Field in Bermuda, Coolidge Field in Antigua, Beane Field in St. Lucia, and Atkinson Field in British Guiana, and the use, as alternatives in emergency, of Carlson and Waller Fields in Trinidad and Vernam Field in Jamaica, has been signed between the United Kingdom and the United States of America. The agreement lays down the terms on which civil aircraft of the two countries and other nations may use these airfields. The United States will, in general, be responsible for the technical operation and maintenance of the airfields, the Colonial Governments for immi-

Civil Aviation News . . . . . .

gration, customs and passenger handling. Air carriers of third nations who will be permitted to use these airfields are, however, requested to continue using existing agencies for handling their aircraft and traffic, and not to apply for accommodation for their own staff, until such time as the Colonial governments concerned are able to provide the necessary permanent terminal facilities. The agreement will last for fifteen years; thereafter it will remain in force for the rest of the 99-year lease, unless either government gives two years' notice of termination.

FIRE EXTINGUISHER SYSTEMS

THE Air Registration Board have issued *Notice No.* 24, issue 2, to licensed engineers and owners of civil aircraft, relating to fire extinguisher systems. Issue 1 of this Notice called for the testing of resistor sockets (Ref. 5c/3230) bearing a particular inspection stamp. It is now revealed that suspected sockets are not confined to those produced by one firm and therefore all sockets (Ref. 5c/3230) are suspect, and may prevent the discharge of the extinguisher bottles. Before further flying all Graviner systems incorporating Mark I, II and VI extinguisher bottles must be tested in accordance with the Notice; all resistor sockets held as spares must also be tested.

U.K. DECEMBER TRAFFIC

FIGURES for air traffic at London Airport in December show that the number of passengers handled on regular scheduled services was 28,305, a figure slightly in excess of the June total and nearly double the figure for December last year. The total weight of mail carried was 876,966lb, and of freight 1,257,301lb, and during December 938 aircraft landed and 955 took off. The total for the whole of 1947 was 281,638 passengers on regular scheduled services involving 17,962 aircraft movements.

Statistics for other airports, diversion traffic excluded, are published below.

	Passengers	Aircraft movements		Mail	Freight
		arr.	dep.	lb.	lb.
Northolt	17,958	649	657	184,360	525,091
Renfrew	4,944	285	294	8,469	18,456
Belfast (Nutts Corner)	4,488	262	262	60,023	38,782
Liverpool (Speke) ...	4,213	209	212	95,654	70,590
Manchester (Ringway)	2,658	217	217	222	72,630
I.o.M. (Ronaldsway) ...	2,129	193	193	22,042	19,294
Southampton	1,949	182	195	84,437	7,646
Prestwick	1,774	198	195	11,811	71,029
Poole	1,024	33	36	30,366	37,548
Edinburgh (Turnhouse)	611	84	84	nil	2,124
Croydon	4	2	2	nil	1,870

The highest number of charter flights handled was at Croydon, with 446 arrivals and 438 departures, and the highest number of private flights was at Weston-super-Mare, with 260 arrivals and 261 departures.

A.O.A. SUMMER SCHEDULES

ON May 1st American Overseas Airlines will start summer schedules. There will be nine Constellation flights weekly between New York and London, and three from New York to Amsterdam and Frankfurt, one of which will serve Boston and fly non-stop to Shannon. DC-4s will fly four times weekly between New York and Germany, including two flights to and from Berlin and one eastbound to Prestwick. In addition four DC-4s will fly from New York to Scandinavia via Keflavik, Iceland. The eastbound service will fly direct from Iceland to Scandinavia, and two of the westbound flights will serve Prestwick. The service to Stockholm will connect with a Dakota shuttle service to and from Helsinki.

NOTICES TO AIRMEN

TABLES have been prepared and are set out in *Notice to Airmen No.* 62 in order that Consol bearings may be plotted when specially prepared charts are not available. These are given as true bearings from the station and the conversion angle must be applied where appropriate. The introduction of a standard beam approach facility at Speke Airport is announced in *Notice No.* 68 which adds that on February 28th the M.F. Landing Approach beacon will be withdrawn from service. *Notice No.* 66 reminds pilots of the possibility of errors being produced in magnetic compasses by ferrous cargoes and draws attention to the necessity of checking magnetic compasses before taking off, whenever ferrous metal cargoes are stowed in close proximity to them. Temporary conditions at present prevailing at a number of airfields are set out in *Notice No.* 65.

FREIGHT CHARGES REDUCED

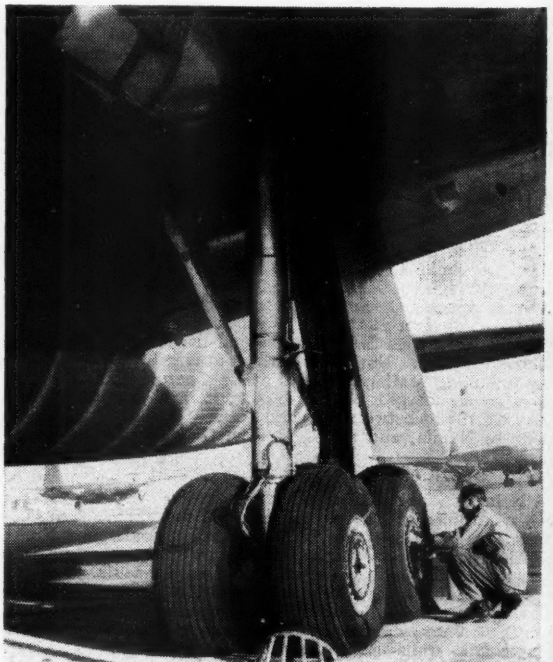
B.E.A. have reduced freight charges on internal air services. In some cases the reduction has been substantial, as for example between London and Belfast, where the rate has been reduced from 2s 9d to 1s 5d per kilogram, and from Edinburgh from 2s 7d to 1s 11d, and from Stornoway and Wick from 3s 8d and 3s 4d to 2s 10d and 2s 8d respectively. Freight for the Continent passing through London will be charged at a still lower rate for the internal section of the journey; for example, to and from Aberdeen the charge will be 1s 10d. The scale of rebate on quantities ranges from between 5 per cent for loads between 26 and 50 kg. to 25 per cent on those over 300 kg. Newspapers are usually subject to a 25 per cent discount.

B.E.A. CONTINENTAL TRAFFIC

THE traffic returns issued by B.E.A. for January, 1948, show a considerable increase in the number of passengers and the amount of freight carried between the U.K. and the Continent. The number of Continental services flown increased by 17.22 per cent and the regularity factor rose from 84 to 92.5 per cent. Comparative figures show that the numbers of revenue passengers were 5,576 in January, 1947, and 9,772 in January, 1948, the weights of freight, ordinary and diplomatic mail carried were increased from 116 to 181 metric tons in the first months of 1947 and 1948 respectively.

DOUBLE TANDEM UNDERCARRIAGE

THE Lockheed Constitution undercarriage has been so designed that the weight of the aircraft, at present 184,000lb, will be distributed over a wide area in order that all airports with runways from 4,500 to 5,500ft in length will accommodate the aircraft without strengthening. More than 50,000 man hours were spent in research and development on these double tandem legs; it is claimed that multiple wheels permit a saving of weight and increase the safety factor in the event of a burst tyre since, under favourable conditions, the Constitution can land safely with any two tyres deflated on a single main leg. Recent flight tests show that the aircraft can take off in 2,350ft and clear a 50ft obstacle in 4,320ft from a standing start at sea level; at its maximum landing weight of 160,000lb it can land over a 50ft obstacle and come to rest in a distance of 2,300ft.



UNDERCARRIAGE BOGIE: A development of the twin wheel undercarriage legs of the Constellation, this four-wheel-per-leg assembly has been successfully tested on the Lockheed Constitution

BREVITIES

AS from March 1st meals on British European Airways' Continental services will be served free of charge to passengers in the air.

* * *

Two Cessna Cranes, bought from the U.S. Army Air Corps in Fiji, have arrived in New Zealand to supplement the government's civil air fleet.

* * *

It is understood that of 149 Douglas DC-6 aircraft delivered and on order, 37 have been purchased by foreign airlines.

* * *

On February 22nd Central African Airways introduced a service between Bulawayo and Victoria Falls, between Salisbury and Livingstone, and from Livingstone to Lusaka. Each service will be flown with Dove aircraft.

* * *

Captain E.S.J. Alcock of B.O.A.C., brother of the late Sir John Alcock, has been transferred to the Corporation's No. 4 (flying-boat) line at Hythe, Southampton Water, to train First Officers.

* * *

Capt. J. C. Kelly Rogers has been appointed assistant general manager (technical) of Aer Lingus, Aerlinte Eireann and Aer Rianta. He was previously technical manager of the first two companies and technical adviser to Aer Rianta.

* * *

Stanstead Airport is now equipped with an M.F. beacon and S.B.A. The equipment was already installed when London Aero and Motor Services took over the airfield on December 12th, 1946, but only recently has it been made operational.

* * *

Sir John S. Buchanan, C.B.E., F.R.Ae.S., has resigned from the board of Short Brothers and Harland, Ltd. Rear-Admiral M. S. Slattery, C.B., F.R.Ae.S., R.N. (Retd.), has been appointed joint managing director with Mr. D. E. Wiseman.

* * *

Indian National Airways are now operating their Viking service between Calcutta and Rangoon every day of the week except Sundays in both directions. A connection at Calcutta makes possible a nine hours' journey between Rangoon and Delhi.

* * *

It is understood that Australian National Airways will continue to operate a service to Vancouver, but on behalf of Trans World Airlines. At present A.N.A. operates the service under charter, but British Commonwealth Pacific Airlines is about to fly on that route.

* * *

Co-operation between Diepen Aircraft and the Nederland Line, Royal Dutch Mail, has led to the foundation of "Aero Holland N.V." The new company will use the fleet formerly owned by Diepen Aircraft, and other aircraft will be purchased for the transportation of freight and passengers.

G/C. R. J. Bone, C.B., C.B.E., D.S.O., has been appointed United Kingdom Civil Aviation Representative in the Far East and Civil Air Attaché to H.M. Embassies at Nanking and Bangkok with residence at Hong Kong. From 1939 to 1941 he commanded the flying-boat base, Pembroke Dock, from which time until 1944 he was R.A.F. Liaison Officer, No. 9 Region Civil Defence.

* * *

American Overseas Airlines have announced an alteration in the administration of their European general office. A "Co-ordinator" is to replace the position of European vice-president and general manager. The new appointment will be filled by Mr. Nelson David in addition to his present duties of European manager of operations.

* * *

From July 1st Trans-Canada Airlines will fly a service taking 14 hours in North Star Mk. II aircraft between Montreal and Vancouver. The transatlantic service between Montreal and the United Kingdom will be stepped up to two flights in each direction daily as from June 1st.

* * *

An airfield costing the Northern Rhodesian government about £300,000 is being constructed at Livingstone, adjacent to Victoria Falls. It has been suggested that runway length will be in the neighbourhood of 7,500ft, modern lighting equipment will be installed, and full immigration and customs facilities will be provided.

* * *

The first session in home territory of I.A.T.A. Traffic Conference No. 3 will start at Sydney, Australia, on March 3rd. Regional rates and tariffs, conditions of carriage and agency matters will be discussed. High traffic officials of British, Australian, Chinese, Dutch, French, Indian, New Zealand, Philippine and American airlines will attend. Mr. C. N. Biondi is the acting secretary.

* * *

Fourteen American, British, Canadian, Danish, Dutch, French, Irish, Swedish and Swiss airlines met in New York on February 24th at the half-yearly meeting of the I.A.T.A. technical committee. The meeting will be devoted mainly to matters of internal organization and preparations will be made for the forthcoming annual I.A.T.A. technical conference at Montreal. Sir Victor Tait represented B.O.A.C. and J. C. Kelly-Rogers represented Irish Air Lines.

* * *

Overhaul periods for Bristol Hercules 630 series engines have been extended from 500 to 600 hours in certain conditions. Approval for the extension is restricted to those operators who have demonstrated by practical experience that it is consistent with the operating conditions imposed. Certain selected engines will be run, with the approval of the Air Registration Board, to approximately 700 hours with a view to possible further extension.

FROM THE CLUBS

NOTWITHSTANDING some adverse weather and the recent snowfall, the Cowes Aero Club has managed to maintain flying activities and in the first six weeks of 1948 there have been four first solos and two members have obtained "A" licences. On March 12th the club will hold its annual ball at the Queen's Hall, Newport, Isle of Wight.

* * *

In order to encourage a large social membership the Luton Flying Club have decided to reduce the social members' subscription to one guinea. It is hoped that many people will first join as social members and ultimately join the flying activities and take instruction at the club. Commenting on the past year's progress the secretary has disclosed that the total flying time amounted to approximately 3,000 hours; he hoped this would be exceeded in the coming year. On Sunday, February 15th, many members took advantage of the improved weather and a total of over 20 flying hours was completed.

* * *

Members of the Wolverhampton Aero Club have continued to patronize the club in considerable numbers and flying instruction during the last month has been continuous. Lectures on navigation and meteorology are held three times a week and are very well attended; the general support of members has been particularly encouraging. Mr. Bickley flew solo on his 17th birthday. A visit of 30 members was paid to the Midland Aero Club at Elmdon recently, motor coach transport having been arranged. Recent acquisitions have brought the number of privately owned aircraft up to the total of 39 machines. Members of other clubs are invited to visit Wolverhampton and are assured of a very warm welcome.

* * *

Commenting on the refusal of the government to subsidize private flying, a number of clubs have announced their determination to carry on their activities as energetically and for as long as possible. At Fair Oaks the rate of £3 per hour for solo or dual flying is the lowest that they can achieve and they hope that members will continue to support the club by putting in more hours as the weather improves. The Cinque Ports Flying Club believes that it will be able to keep going as before and will make every effort to do so; they have set their rates at the lowest possible level. The reaction of the United Services Flying Club is the same. The Herts and Essex Aero Club is to continue as before and, despite the fact that there is no prospect of reducing rates any further, it is hoped that members will complete as many hours as they can. The basic petrol restriction has reduced the social activities of many clubs since, although members can obtain a petrol allowance for travelling to and from their clubs for the purpose of flying, many of those who have laid up their cars are not prepared to put them into commission again for this purpose alone. The inevitable disappointment caused by Lord Nathan's announcement appears to be accompanied by the strong determination of many clubs to carry on in the hope of better times in the future.

COMMONS DEBATE

Committee to Examine Ordering Procedure : Questions on Efficiency of Present Organization and on Corporations' Balance Sheets

LITTLE that was new was revealed in the debate on civil aviation in the House of Commons on Thursday, February 26th. There were two announcements, one by Mr. G. R. Strauss, Minister of Supply, and another by Mr. G. S. Lindgren, the Parliamentary Secretary to the Ministry of Civil Aviation. The former stated, after criticism had come from Mr. Lennox-Boyd ot the system for ordering aircraft, that in order to make sure whether the present system was good and to find out whether improvements could be made the Government intended to consult certain business and administrative people. The names of those whose advice would be sought were Mr. Hanbury-Williams, chairman of Courtauld's, Sir Rowland Smith, managing director of Ford's, and Mr. George Wansbrough, chairman of Reyrolle, who was a member of the Tudor Committee of Inquiry. Until the Government had the advice of those gentlemen, Mr. Strauss said, it would be wrong to state the Government's view on the ordering procedure. Mr. Lindgren later announced that the Minister of Civil Aviation had decided that, in the circumstances of the disappearance of *Star Tiger*, the British South American Airways Tudor IV, on a flight from the Azores to Bermuda on January 30th, a formal court investigation would be more reassuring to the public. Lord Macmillan, a former Lord of Appeal in Ordinary, had accepted an invitation to hold the formal court of investigation.

Foreign Examples

In opening the debate Mr. Lennox-Boyd said that a discussion on civil aviation was urgent and he proceeded to name a number of incidents which had added to the national disquietude. Resignations and dismissals in the Corporations and departments had taken place, and recently published reports had given a gloomy picture. He drew attention to the losses of the Corporation and to the success of Continental operators such as K.L.M. and Sabena, both of which had succeeded as private enterprises with a government interest. The Opposition did not believe, he said, that State-owned monopolies would work and they were under obligation to restore the wide measure of freedom in the air when the chance came. Speaking of aircraft for the Corporations, Mr. Lennox-Boyd said it had been suggested that the Corporations should ask the manufacturers in this country to make American aircraft under licence. He suggested that the time involved in such a process would gain us nothing. We ought to be in a position to provide equal and superior aircraft within the same period of time. He also asked for information on the Canadian offer for leasing DC-4M aircraft built in Montreal by Canadair. We must not lose sight of the fact, he said, that the aircraft industry mattered very much to this country in peace and in war, and the Government through their home monopolies really had complete control of the activities of the British industry. Mr. Lennox-Boyd paid tribute to the exports of the aircraft industry. He also asked about the Brabazon I, the Saunders-Roe flying boat, the Tudor I, the Hermes and the Bristol M.R.E.

Mr. George Wansbrough.

Even if the Corporations were given the aircraft they needed, they would still be called upon to do uneconomic and uncommercial things, he suggested, and it would be ungenerous to attack them for expenses incurred for tasks imposed on them which were not commercial. He suggested that the routes flown should be divided into commercial and political routes in order that criticism could be levelled at commercial routes and they could then be judged by the ordinary yard-stick of industry. In conclusion, Mr. Lennox-Boyd said that there would be no real solution until there was a change in policy. He was referring to an earlier statement that the Opposition believed in freedom in the air and the right of some independent body to licence operators, including government operators, if they could make out a case that they could run a line proficiently and safely.

Mr. Strauss said that the Ministry would be able to take a number of major decisions within a very short time and we would then know more firmly what aircraft could be flown in five years' time. Among the aircraft that were being developed there would be one, and they hoped more, that would be equal to those flown in any other part of the world. In defence of the heavy losses incurred by B.O.A.C., Mr. Strauss referred to the maintenance of uneconomic bases and it was unavoidable in the future that B.O.A.C. would be forced to operate at a book loss. B.E.A. had suffered, he said, from the effect of the travel ban, and B.S.A.A., whereas when they started operations had almost a monopoly and were able to show a profit, would probably be unable to show the same monetary results since they had undertaken new routes over which there was considerable competition Mr. Strauss suggested that the nationalized airlines were not inefficient.

A. Cdre. Harvey considered that since the debate hinged mostly upon the ordering of aircraft the House should have been told more about it. He thought that B.E.A. should not be called upon to bear the loss of £26,000 on cancelled priority seats. In view of the hire of Lancastrians and Yorks by B.S.A.A., he suggested that that Corporation's profit of £32,000 could not be accepted. He further suggested that action against A.V-M. Bennett should have been taken last November when an aircraft landed at Bermuda with less than 100 gall. of fuel. A. Cdre. Harvey considered further that the boards of the Corporations should be reviewed, and mentioned by name Lord Burghley and Lord Rothschild as not being qualified for such appointments. He had, however, every confidence in Mr. Whitney Straight.

Sir Rowland Smith.

Mr. Ivor Thomas paid tribute to the achievements of B.S.A.A. and said that there was a good spirit in the Corporation. He gave comparative figures of the earning ability in the three Corporations.

There were several appeals for financial aid for the flying clubs, particularly from Sir W. Smiles, and S/L. Kinghorn. Sir B. Neven Spence thought that it was disgraceful that three of the pioneers on Scottish aviation, Messrs. Cumming, Barclay and Fresson, had been declared redundant by B.E.A.C. Mr. Ward was surprised that the Minister of Supply did not know whether the Canadair was being considered or not by anybody. He suggested that a commission similar to President Truman's commission in America should be set up.

Mr. Lindgren had very little time to reply to the many questions, but expressed his appreciation of the general tenor of the debate and the helpfulness which everyone had shown in regard to the furtherance of civil aviation in this country. It was wrong, he said, to compare the size of the Air Ministry section in pre-war days with the Ministry of Civil Aviation to-day. There were at that time only two State-owned airfields: Heston and Croydon; the rest were small and owned by municipalities or private flyers, and also in those days navigational aids were poor and aircraft were small. Since the war, development in aircraft and aids had necessitated an enormous increase in manpower. The Parliamentary Secretary said that money had been lost in civil aviation as the result of the deliberate policy of the Government to fly British. In comparing K.L.M. with B.O.A.C. he said that the Dutch company operated services on the basis of paying for services developed by others, and no organization was maintained along their trunk routes. He assured the House that there was no intention of amalgamating the Corporations into one. They had been formed with the intention of creating a healthy spirit of rivalry and, although it had led in certain sections to overstaffing and duplication, there had always been co-operation at the top. He said that there would be no rebate of fuel tax for the Corporations. Referring to a question from A. Cdre. Harvey on the late ordering of the Ambassador, Mr. Lindgren emphasized that the Corporations could not be expected to develop every aircraft which came on the market. Their aim as operators was to get as limited a range of types of aircraft into operation as possible. Mr. Lindgren wound up the debate by paying tribute to the staffs of the three Corporations.

LODGE
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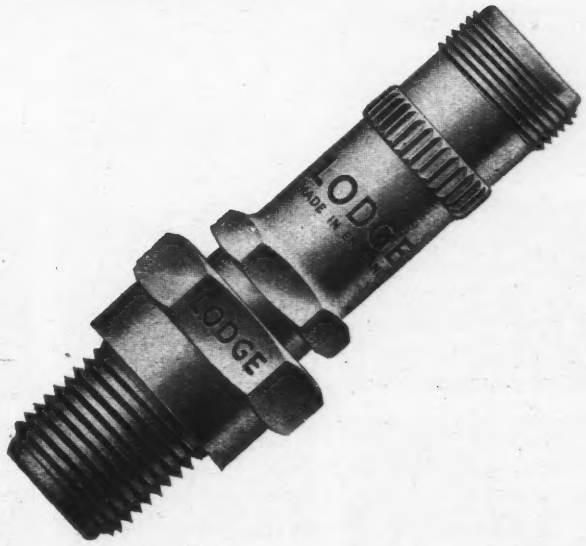

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Aircraft Design Procedure

Neither Works of Art nor Works of Engineering Can be Produced by Committees

AIRCRAFT design has become a very complicated business, and few people outside the industry have any very clear idea of what is involved, or why it takes so long to produce a new type of aircraft. Last Thursday the Royal Aeronautical Society was given an outline of the evolution of the design of an aircraft, by Professor R. L. Lickley, B.Sc., D.I.C., F.R.Ae.S., whose special task at the new College of Aeronautics at Cranfield is to initiate students into the mysteries of aircraft design. As we feel that many of our readers will take a more charitable view of the aircraft designer if they understand something of his difficulties, we are publishing a fairly extensive summary of Professor Lickley's lecture. It might be mentioned that his new title does not indicate that he is merely an academician. For many years he was on the Hawker technical staff under Mr. Sydney Camm, and when he speaks of the maze of complications by which the designer is pestered, he does so from very real and very practical experience.

Professor Lickley pointed out that the design of an aircraft is a long and tricky business, in which compromise is constantly required. As a result, aircraft design is still an art rather than a science, and likely to remain so. He likened it to the creation of a picture from a jigsaw puzzle, with the added complication that some of the pieces change shape while waiting to be fitted into the picture.

There are two main ways in which the design of an aircraft begins: In one, the designer has an instinctive feeling that a certain design is the best for a particular purpose; in the other, a rigid specification is presented by an outside body, giving little overall freedom of design. The former, the lecturer thought, results in the best design. It used to be known as a private venture, or P.V. The rising costs have made it difficult for a firm to undertake private ventures.

When either the Air Staff or an operating company requires a new aircraft, the respective branches of the Ministry of Supply issue to selected firms a statement giving main requirements such as speed, range, disposable load, and so on. From this, the project branch of the firm can start investigating various designs, the best of which will eventually be submitted as a tender. A typical preliminary requirement might be as follows:—

Proposed General Requirements

A commercial aircraft is required for general airline duties. It should carry two crew and 20-24 passengers with an allowance of 45 lb per passenger for baggage.

It is of major importance that it should have very good take-off and landing characteristics and be able to meet all I.C.A.O. requirements when using airfields with 800-yard runways.

The performance is to be the best possible, bearing in mind the above take-off and landing requirements and the cruising speed should not be less than 180 m.p.h. at 10,000 feet at 50 per cent of take-off power.

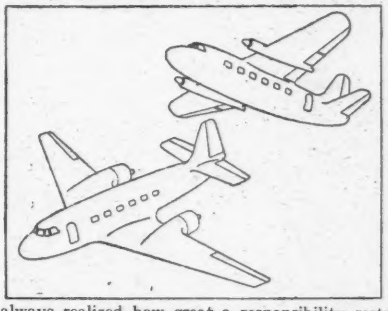
Pressurization is not required.

It should be capable of carrying full load on a stage distance of 200 miles. Full fuel allowances must be made on this distance for taxi-ing, take-off and landing, together with satisfactory allowances for adverse winds, hold-ups in control zone, and so on. These should not be less than 200 miles at cruising speed and 1½ hours at minimum fuel consumption speed. The maximum stage distance required is 500 miles.

The design should be such that the possible utilization will not be less than 2,000 hours a year.

The initial rough stages in the project office are exemplified in the sketch designs.

During the preparation of the tender, much project work is done by the firm, and may represent thousands of hours of work and the preparation of many drawings. At this stage, decisions must be taken which can make or mar the whole design. They include such matters as aircraft shape, wing loading and high-lift devices, and, most important of all, choice of power plant and estimate of all-up weight.



The shape of the aircraft allows the designer to show his individuality. Once the general lines are decided upon, they are rarely altered except in detail. It is not always realized how great a responsibility rests on the designer at this stage. The full requirements are not known, but the designer must use his experience and instinct to produce something which will be the best for the ultimate duties of the aircraft.

Coupled closely with the overall shape is the wing plan form, the decision to have small wing areas and expensive flaps, or large areas and simple flaps.

Next comes the choice of power plant. This was difficult enough when there was only the piston engine. Now, with jets, airscrew turbines, reciprocating types and compound engines, the choice needs great forethought and skill. The designer is in the hands of the engine man in such matters as engine weights, powers, and specific consumption. The desire to believe the optimistic figures is hard to fight down. The best designs are those in which the designer has guessed right as to the best future power plant, and has tempered the optimism of the engine firm with more conservative estimates.

The over-optimism of the engine people on the future of airscrew turbine units has led to a difficult situation in this country with regard to new civil types. Greater faith in the piston engine might have given very different answers to the operators' problems.

Accurate estimation of the all-up weight is a fundamental problem in the project stage. Bad weight estimation can destroy the machine's chance of success. In the past, insufficient attention was often paid to this, and fantastic estimates were often submitted with tenders. There is still a saying that an aircraft goes into service 20 per cent heavier than the tender-estimate. This is not the manufacturer's fault; equipment changes and goes up in weight; power plants go up in weight. A strong weight section, with plenty of data and in close touch with the project section, can produce a much more realistic estimate than was often used in the past.

The next stage is represented by the submission of the tender. At this stage the committees get to work, and it is difficult for one closely connected with design to speak objectively of this matter. Neither works of art nor works of engineering can be produced by committees. They are, however, necessary in small quantities and at long intervals, to ensure that the contractor is provided with a firm contractual agreement; that he has all the help he needs (technical and otherwise); and to check at the end that the final design bears a close relationship to the specification.

When tenders have been submitted, there is a meeting of what might be called the tender-acceptance committee, composed of representatives of the M.o.S. and the user, but not normally including representatives of the design firm. This committee decides which tender is best and what changes can be asked for or inflicted on the designer. This is followed by a getting-together of the prospective purchaser and the designer, to hold a bargaining match—the purchaser to see how much extra he can get and the designer to stand firm by his existing tender which, after all, represents his best ideas. However, the firm probably needs the order, and the designer may be forced, against his better judgment, to accept amendments which do not improve the design. On the basis of this meeting a full specification can be drawn up, and this represents the contractual requirements. In most cases it is a never-ending source of argument from then on.

(To be continued)

STAGES IN DEVELOPMENT

Stage	Section of firm		
	Design	Experimental	Production
1. Development of design.	Investigation of requirements. Preparation of tender.		
2. Specification stage.	Specn. accepted. Lines being developed. W.T. work, etc., starting.	Discussions on mock-up. Methods of manufacture.	
3. Mock-up	Completion of lines. Investigation of structure, layout, etc.	Manufacture of mock-up. Start on jigs.	
4. Main design work.	Wind tunnel tests. Main structural details.	Jigs completed. Main structure started.	Discussions on production, jigs, materials, etc.
5. Prototype completion.	Drawings to be completed. Detail requirements agreed. Completion of stressing.	Functional mock-ups. Prepn. of test specimens. Completion of building. Tests prior to flight.	Continuance of 4. Study of Exp. shop methods.

THE AIR ESTIMATES

Aim : An Efficient Striking Force Ready at Short Notice

IN his Memorandum on the 1948-49 Air Estimates, the Air Minister, Mr Arthur Henderson, stresses the difficulties with which the R.A.F is faced due to the fact that only about 40 per cent of the Service are regulars, and that consequently effort has to be concentrated on training.

The Air Minister states that special attention is being given to the training of the bomber force, in the realization that the existence of efficient striking forces is the country's most effective safeguard against aggression. Great importance is attached to increasing the mobility of the force and reducing its dependence on a widespread and elaborate base organization. It is the aim of the Air Council to enable a substantial weight of air power to be developed at short notice in any area.

On the subject of equipment, the Memorandum states that provision is made for further re-equipment of fighter squadrons with jet-propelled aircraft.

Following are summarized details of the votes under which the total net expenditure of £173 million is made up.

VOTE 1 : PAY, ETC., OF THE AIR FORCE. (£51,700,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Pay of officers	10,865,000	13,395,000	— 2,530,000
Pay of airmen and airwomen	30,450,000	38,338,500	— 7,888,500
Pay of native personnel of local forces abroad	270,000	257,000	+ 13,000
Marriage and dependants' allowances	8,500,000	9,922,500	— 1,422,500
Lodging allowance and London allowance	435,000	494,750	— 59,750
Local overseas allowance	1,245,000	1,182,900	+ 62,100
Miscellaneous allowances	134,000	239,350	— 105,350
Contributions under National Insurance schemes	1,510,000	1,650,000	— 140,000
Extended service bounties to airmen	40,000	450,000	— 410,000
War gratuities and Service post-war credits	1,000	170,000	— 169,000
Gross total	53,450,000	66,100,000	—12,650,000
Deduct : Appropriations in Aid	1,750,000	5,800,000	4,050,000
Net total	51,700,000	60,300,000	— 8,600,000

The decrease in the gross total of this Vote is mainly due to the continuing contraction of the Royal Air Force. The rates of pay of officers in the Women's Auxiliary Air Force are under review.

VOTE A : MAXIMUM NUMBER OF OFFICERS, AIRMEN AND AIRWOMEN TO BE MAINTAINED FOR AIR FORCE SERVICE. (325,000)

	1948–49			1947–48		
	Officers	Airmen and Airwomen	Total	Officers	Airmen	Total
Royal Air Force	25,000	291,000	316,000	32,000	322,000	354,000
Dominion Forces	190	10	200	200	50	250
Colonial Forces	110	3,090	3,200	60	2,690	2,750
Polish Resettlement Corps	1,400	4,200	5,600	2,000	11,000	13,000
Total	26,700	298,300	325,000	34,260	335,740	370,000

The number of personnel on release leave included in the maximum number is 53,000.

VOTE 2 : RESERVE AND AUXILIARY SERVICES. (£725,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Pay, etc., of personnel of the Royal Air Force Reserve	53,000	5,000	+ 48,000
Pay, etc., of personnel of the Royal Air Force Volunteer Reserve	228,000	325,000	— 97,000
Pay, etc., of personnel of the Royal Auxiliary Air Force	94,000	130,000	— 36,000
Pay, etc., of personnel of the Women's Auxiliary Air Force/R. list and V.R. list (flying)	28,000	30,000	— 2,000
Grants to Territorial and Auxiliary Forces Associations	50,000	50,000	—
Air Training Corps	137,000	162,000	— 25,000
Combined Cadet Force	43,000	—	+ 43,000
Pay, etc., of members of the Royal Observer Corps	88,700	91,300	— 2,600
Miscellaneous services	3,600	7,000	— 3,400
Gross total	725,300	800,300	— 75,000
Deduct : Appropriations in Aid	300	300	—
Net total	725,000	800,000	— 75,000

The decreased provision is mainly due to the development of the R.A.F.V.R. and R.Aux.A.F. being slower than was expected when the 1947-48 Estimates were prepared.

ABSTRACT OF AIR ESTIMATES, 1948–49

Vote	Service	Estimates, 1948–49 Gross Estimate	Appropriations in Aid	Net Estimate	Estimates, 1947–48 Gross Estimate	Appropriations in Aid	Net Estimate	Differences on Net Estimates Increase (+) Decrease (—)
A	Maximum number of Officers, Airmen and Airwomen to be maintained for Air Force Service			Maximum Number 325,000			Maximum Number 370,000	Number 45,000
		£	£	£	£	£	£	£
1	Pay, etc., of the Air Force	53,450,000	1,750,000	51,700,000	66,100,000	5,800,000	60,300,000	8,600,000
2	Reserve and Auxiliary Services	725,300	300	725,000	800,300	300	800,000	— 75,000
3	Air Ministry	3,011,200	1,200	3,010,000	3,045,500	2,500	3,043,000	— 33,000
4	Civilians at Outstations	18,139,000	270,000	17,869,000	18,199,000	184,000	18,015,000	— 146,000
5	Movements	7,979,000	1,162,000	6,817,000	14,283,000	787,000	13,496,000	— 6,679,000
6	Supplies	20,609,500	2,959,500	17,650,000	24,715,000	3,315,000	21,400,000	— 3,750,000
7	Aircraft and Stores	58,800,000	10,800,000	48,000,000	69,964,000	10,968,000	58,996,000	— 10,996,000
8	Works and Lands	25,700,000	2,700,000	23,000,000	31,000,000	3,000,000	28,000,000	— 5,000,000
9	Miscellaneous Effective Services	3,287,000	1,708,000	1,579,000	8,542,000	1,110,000	7,432,000	— 5,853,000
10	Non-Effective Services	2,695,000	45,000	2,650,000	2,538,000	20,000	2,518,000	+ 132,000
	Total	194,396,000	21,396,000	173,000,000	239,186,800	25,186,800	214,000,000	Net Decrease £41,000,000

VOTE 3 : AIR MINISTRY. (£3,010,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Salaries, wages, etc.	3,011,200	3,045,500	— 34,300
Deduct :			
Appropriations in Aid	1,200	2,500	1,300
Net total ... ...£	3,010,000	3,043,000	—33,000

The decrease in the net total is due to a reduction in the civilian staff of the Air Ministry.

VOTE 5 : MOVEMENTS. (£6,817,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Conveyance of personnel; travelling allowances and expenses	5,765,000	8,065,000	— 2,300,000
Conveyance of stores	2,214,000	6,218,000	— 4,004,000
Gross total ... ...£	7,979,000	14,283,000	— 6,304,000
Deduct :			
Appropriations in Aid	1,162,000	787,000	+ 375,000
Net total ... ...£	6,817,000	13,496,000	— 6,679,000

The decrease in the gross total is mainly due to a reduction in the movement of personnel and stores arising from the contraction and reorganization of the R.A.F.

VOTE 7 : AIRCRAFT AND STORES. (£48,000,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Aircraft	38,730,000	42,750,000	— 4,020,000
Armament and explosive stores ...	2,550,000	6,250,000	— 3,700,000
Radio, radar and electrical equipment...	4,400,000	4,400,000	—
Instruments and photographic equipment	1,550,000	1,230,000	+ 320,000
Mechanical transport vehicles and marine craft	2,075,000	3,500,000	— 1,425,000
Miscellaneous equipment, materials and technical services	2,875,000	3,620,000	— 745,000
Meteorological equipment	310,000	343,000	— 33,000
General stores	2,110,000	2,420,000	— 310,000
Clothing and clothing allowances ...	4,035,000	5,271,000	— 1,236,000
Medical stores	165,000	180,000	— 15,000
Gross total ... ...£	58,800,000	69,964,000	—11,164,000
Deduct :			
Appropriations in Aid	10,800,000	10,968,000	168,000
Net total ... .£	48,000,000	58,996,000	—10,996,000

The decrease in the net total of this Vote is mainly due to a greater allowance being made for technical and other difficulties in achieving programmes. For aircraft and repairs to airframes a sum of £23,460,000 has been set aside. Airframe spares, airscrews and gun turrets account for £8,570,000; aircraft engines, £6,700,000.

VOTE 9 : MISCELLANEOUS EFFECTIVE SERVICES. (£1,579,000.)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Fees and other payments for personal services	145,000	133,000	+ 12,000
Charges for training personnel at courses outside the Royal Air Force	1,000,000	1,070,000	— 70,000
Miscellaneous educational services ...	80,000	158,000	— 78,000
Grants in aid of Institutions and Associations	12,000	19,000	— 7,000
Welfare Expenses	76,000	148,000	— 72,000
Publicity Expenses	45,000	50,000	— 5,000
Compensation for losses, damage, etc. ...	178,000	302,000	— 124,000
Charges for hospital services	70,000	81,000	— 11,000
Banker's commission, etc.	10,000	7,000	+ 3,000
Telecommunication and postal expenses	285,000	766,000	— 481,000
Miscellaneous expenses	245,000	178,000	+ 67,000
Rebate in respect of military stores of lend-lease origin issued to certain governments	—	2,800,000	—2,800,000
Pay, etc., of Polish personnel	1,056,000	2,800,000	—1,744,000
Payments for enemy prisoners of war ...	85,000	30,000	+ 55,000
Gross total ... ...£	3,287,000	8,542,000	—5,255,000
Deduct :			
Appropriations in Aid ... ...£	1,708,000	1,110,000	+ 598,000
Net total ... ...£	1,579,000	7,432,000	—5,853,000

The decrease in the gross total is mainly due to the contraction of the R.A.F. and of the Polish Resettlement Corps (R.A.F.).

VOTE 4 : CIVILIANS AT OUTSTATIONS. (£17,869,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Salaries, wages, etc., of works staff ...	2,330,000	2,000,000	+ 330,000
Salaries, wages, etc., of meteorological staff	800,000	877,100	— 77,100
Salaries, wages, etc., of aeronautical inspection staff	226,000	285,000	— 59,000
Salaries, wages, etc., of other scientific and technical staff	79,000	94,900	— 15,900
Salaries, wages, etc., of educational staff	55,000	70,000	— 15,000
Salaries, wages, etc., of miscellaneous non-industrial staff	5,174,000	5,214,000	— 40,000
Wages, etc., of industrial employees ...	9,475,000	9,658,000	— 183,000
Gross total ... ...£	18,139,000	18,199,000	— 60,000
Deduct :			
Appropriations in Aid	270,000	184,000	+ 86,000
Net total ... ...£	17,869,000	18,015,000	— 146,000

The decrease in the gross total is mainly due to a reduction in staff consequent on the contraction of the R.A.F.

VOTE 6 : SUPPLIES. (£17,650,000)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Provisions and ration allowances ...	10,614,000	12,350,000	— 1,736,000
Fuel and light	2,853,500	3,266,000	— 412,500
Petrol, oil and lubricants	6,690,000	8,600,000	— 1,910,000
Miscellaneous supplies and accommodation services	452,000	499,000	— 47,000
Gross total ... ...£	20,609,500	24,715,000	— 4,105,500
Deduct :			
Appropriations in Aid	2,959,500	3,315,000	355,500
Net total ... ...£	17,650,000	21,400,000	— 3,750,000

The decrease in the total is mainly due to the contraction of the R.A.F.; partly offset by increase in prices.

VOTE 8 : WORKS AND LANDS. (£23,000,000.)

	Estimates 1948–49	Estimates 1947–48	Increase (+) Decrease (—)
	£	£	£
Part I—New works, additions and alterations amounting to £10,000 each and upwards	9,750,000	10,500,000	— 750,000
Part II—New works, additions and alterations under £10,000 each ...	500,000	600,000	— 100,000
Part III—Ordinary repairs, renewals and maintenance	10,000,000	12,000,000	—2,000,000
Plant for use on works services	300,000	200,000	+ 100,000
Grants towards the cost of works ...	20,000	100,000	— 80,000
Purchases of lands and buildings ...	2,750,000	3,500,000	— 750,000
Rents and reinstatements	2,350,000	4,000,000	—1,650,000
Surveys and miscellaneous services ...	30,000	100,000	— 70,000
Gross total ... ...£	25,700,000	31,000,000	—5,300,000
Deduct :			
Appropriations in Aid	2,700,000	3,000,000	300,000
Net Total ... ...£	23,000,000	28,000,000	—5,000,000

The decrease is due to continuing reduction in the number of establishments being maintained, and to the deferment of works services.

For Vote 10 (Non-effective Services) a net sum of £2,650,000 is set aside in the Estimates. This represents an increase of £132,000 compared with last year, mainly due to an increase in the number of officers on the retired list, and to increased provision for gratuities payable under special schemes to personnel who will leave the service in 1948-49.

The largest items are retired pay, half-pay, wounds pensions and gratuities to officers (£1,670,500), and pensions and gratuities to airmen (£533,500).

Disability awards in cases where disability or death is attributable to service in the two wars are awarded by the Ministry of Pensions.

Included in this Vote are payments of superannuation and compensation allowances, additional allowances and gratuities to civilians or their dependents employed under the Air Ministry. The Vote also provides for compensation to civilians injured whilst in Air Ministry employment and, in certain circumstances, to their dependents; and for disability awards arising from special risks in the Air Training Corps. The largest item is the superannuation (£102,000).

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

THE R.A.F.V.R.

Too Little Assistance for Recruiting Drives

I READ with interest the letter from your correspondent "474" in your issue dated February 19th, and most heartily agree with all his comments.

As a Reserve Flying School instructor I have been able to discuss this matter of recruiting for the R.A.F.V.R. with a number of reservists, and the amazing thing seems to be, not that so few recruits are coming forward, but that any are forthcoming at all! The chief reason for this would appear to be the almost complete lack of publicity given to the R.A.F.V.R., most of what is being given is organized as a private venture, either by the Reserve Centre commandants or by the civilian companies operating the Reserve Schools, or by a combination of both. Further, no financial assistance appears to be forthcoming from "higher-up" for recruiting drives, publicity, and what not. So is the lack of response really so surprising after all? DONALD A. S. McKAY.

Desford, Leicester.

P.S.—I suspect "474" of being one of our own reservists here at Desford!

ON GETTING LOST

It Has Happened to Most Pilots

I READ with interest and some amusement your recent correspondence headed "Women Pilots" and "On Getting Lost" by Mr. Keith-Jopp (December 25th, 1947), and Mr. H. Mason (February 5th) respectively.

In the first, by Keith-Jopp, he stated, only to force his argument, that eleven R.A.F. pilots had lost themselves; and in the second Mr. Mason showed no mercy in letting readers know that Keith-Jopp had once lost himself.

Whether or not Mr. M. likes Mr. K-J. I don't know. I also do not know whether or not Mr. Mason is a pilot; I suppose he is. If so, has he ever been lost?

I myself have done almost 2,000 hours' flying, and although I have not actually been lost, I have at times been *doubtful*, and I think if we pilots are honest about this, we will all agree that there has been some time in our careers when we have been—to quote a former C.O. of mine—"temporarily misplaced."

I am unemployed at present, but I must say that, should the deciding factor of whether or not I gained a position be the honest and truthful answer to an employer's question: "Do you think you would ever get lost?" I'm afraid I should stay jobless. ARTHUR COOK.

Dipton, Newcastle-on-Tyne.

THE INFORMAL LIGHT AIRCRAFT COMMITTEE

Aimed at Avoiding Maintenance

I WOULD like to answer various points raised in your correspondence columns by Mr. W. J. Andrews (January 29th) and Mr. David G. Thorpe (February 12th).

As I was a completely independent technical member of the Informal Light Aircraft Committee up to the time of the publication of the Report, I can speak without bias.

The object of the Committee was to draw up a suggested specification for a new generation of civil trainer-tourer aircraft having markedly better characteristics than any existing types; better characteristics, that is, in safety, long life and easy maintenance. Other features were to be sacrificed, and all the way through the Report runs this emphasis on safety and easy maintenance. How bad earlier types of trainers had been in these respects was only too well known.

In Annexe B (Part II). paragraph 2(b), we noted the need for:

> "(ii) Reduction of inspection, maintenance and overhaul costs."

The theme is repeated in the next paragraph, 2(c), where we said:

> "Any reasonable compromise in the specification as now set out will be considered if it has as its result the introduction of an appreciable improvement of robustness of construction, economy of servicing, etc. . . ."

In paragraph 10, dealing with the undercarriage, we called for a guard to prevent airscrew damage, and we banned oleo-pneumatic shock absorbers, and either hydraulic or pneumatic brakes. Elsewhere we banned folding wings on similar grounds.

So the story goes on right through the Report. Paragraphs 12 and 16 of Annexe B, and the whole of Annexe D are devoted to it.

The point of all this is that the designer, to whom the Report was primarily addressed, has it in his power to emphasize certain features in his design at the expense of other features. We asked him on nearly every page to stress ease of maintenance and so to help make club flying possible by reducing its cost.

The actual figures of relative salaries of pilots, club secretaries and licensed engineers were, to the best of our knowledge, those ruling at the time, and it was no part of our purpose to enter into controversy on them. They are settled or altered by committees very different from the Informal Light Aircraft Committee and I, personally, am surprised that the chairman of the Society of Licensed Aircraft Engineers should have pitched on our work in that respect. There are more fruitful methods of raising salaries than in giving side kicks to bodies which have no powers in the matter. If Mr. Andrews succeeds in raising salaries, the result would appear purely objectively in future reports of the Informal Light Aircraft Committee.

Regarding Mr. Thorpe's point of the need for first-class maintenance, so much was the Committee aware of it that they tried to do away with it in the future. It emphasizes the designer's failure in the past. MARCUS LANGLEY.

Redhill Surrey.

AUXILIARY RAM-JETS

Could They be used on Piston-engined Fighters ?

IN view of the fact that jet propulsion is taking the field in the fighter aircraft class, would it not be possible to equip the existing high-powered piston-engined aircraft with an auxiliary ram-jet unit fitted beneath the fuselage, in order to give that "little bit" extra under combat conditions?

As most fighter aircraft attain 400+ m.p.h., the effect on the ram-jet unit might provide a useful propelling jet on the application of ignition and fuel. No doubt the range of the aircraft would suffer in order to cater for the fuel for the jet unit, but for a short-range, home-defence aircraft such limitations of range might be worth while.

Additional accessories on the instrument panel would at the outside amount to two small switches, one to complete the ignition circuit for initial burning of fuel in the jet combustion chamber, and the other for turning-on the fuel supply. The fuel pump could be driven off the main power unit, and when the jet unit was not in operation a pressure relief valve would allow the pump to circulate the fuel back to its inlet port.

On the pilot's operation of the press-button or switch, a solenoid could open the fuel line and the drop in pressure would close the pressure relief valve, with subsequent supply of fuel to the jet nozzle.

This is, of course, purely surmise, but this country must not be caught again with aircraft unable to cope with an enemy air force without losing gallant airmen.

Chelsea, S.W.1. T. BRAUN.

[*A number of letters have had to be held over.*—ED.]

FORTHCOMING EVENTS

Mar. 4th.—R.Ae.S. (Gloucester and Cheltenham): "Castings and Forgings." A film introduced by C. F. Ingram.
Mar. 10th.—R.Ae.S. (Preston): "Bird Flight." Capt. J. L. Pritchard, Hon. F.R.Ae.S.
Mar. 10th.—Royal United Service Institution: "Progress in Aircraft Design," B. N. Wallis, C.B.E., F.R.S.
Mar. 11th.—R.Ae.S. (Yeovil): Lecture by P. G. Masefield, M.A., F.R.Ae.S.
Mar. 12th.—Institute of Navigation: "Air Sextants. F. F. Everitt, B.Sc.
Mar. 16th.—R.Ae.S. (Belfast): "Inside Occupied Japan" W. Courtenay, M.M., A.R.Ae.S.
Mar. 18th.—Royal Aeronautical Society: "Flight Testing at High Subsonic Speeds." H. Davies, B.A., M.Sc., A.F.R.Ae.S.
Mar. 20th.—Society of Licensed Aircraft Engineers: "Brains Trust," in co-operation with the N.C.A. and A.R.B. Question Master, R. H. Hardingham, O.B.E.
Mar. 22nd.—R.Ae.S. (Bristol): "Operation of Civil Transport Aircraft." N. E. Rowe, C.B.E., F.R.Ae.S.
Mar. 25th.—R.Ae.S. (Yeovil): "Recent Developments in Flying-Boats." H. Knowler, F.R.Ae.S.
Mar. 31st.—Royal United Service Institution: "Atomic Energy." Prof. H. S. W. Massey, F.R.S.

In Production – for the Royal Air Force

The Percival Prentice T. Mark I three-seat trainer is now in production for use by the Royal Air Force both at home and overseas. Its uses include basic flying training, aerobatics, instrument and night flying, navigational and radio training. Designed to Air Ministry Specification, the Prentice is of metal construction and is powered by a 250 h.p. De Havilland Gipsy Queen "32" engine. Electric intercommunication and radio, including Standard Beam Approach equipment, are fitted.

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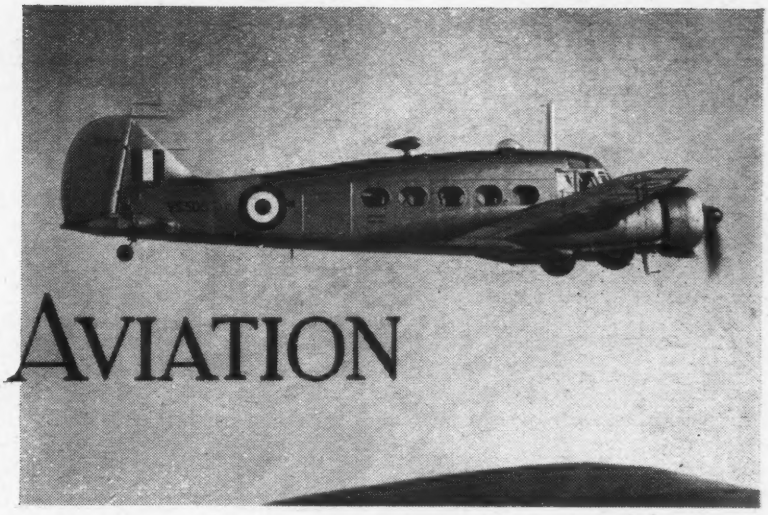


ANNIE A LA MODE: One of the new Avro Anson T.XX navigational trainers for service in Rhodesia. In the same series are the Marks T.21 (navigational trainer for Home service) and T.22 (radio trainer).

"*Flight*" *photograph*

Awards

THE KING has been graciously pleased to approve the following awards:—

Military Medal.

(1) *Acting Warrant Officer D. E. Payne, R.A.F. Volunteer Reserve, No. 2909 Squadron, Royal Air Force Regiment.*—During enemy attacks on the island of Cos, in September and October, 1943, Warrant Officer Payne was in charge of a battery of six guns, whose position covered the western approaches to Antimachia airfield. This battery bore the brunt of many high level bombing attacks which preceeded the invasion of the island. The vicious methods used by the enemy were extremely harassing to the gunners, who had to man the 20 m.m. guns against aircraft which kept well out of range. After the bombing attacks had ceased, enemy fighters took up the attack with concentrated fire from cannon and machine guns, only to be met with determined and accurate opposition from the few guns in Warrant Officer Payne's battery which remained serviceable. Throughout the heavy high level bombing attacks Warrant Officer Payne remained calm and undisturbed. He visited each of his guns in turn on a motor cycle and, where casualties had been sustained, he rallied the survivors. Finally, owing to heavy casualties, he took over the duties of number one gunner of one of his guns, and continued to oppose all enemy attacks. Warrant Officer Payne's devotion to duty undoubtedly encouraged not only his own battery but all members of the squadron. He certainly raised the morale of the gunners who had become discouraged by the ineffectiveness of their efforts against the enemy.

(2) *Leading Aircraftman W. W. Tucker, R.A.F. Volunteer Reserve, No. 2909 Squadron, Royal Air Force Regiment.*—During enemy attacks on the island of Cos, during September and October, 1943, Leading Aircraftman Tucker was number one gunner on an anti-aircraft gun which formed part of the defences of Antimachia airfield. This gun was subject to particularly heavy low level attacks by the enemy fighters. Throughout these attacks, this airman displayed courage and determination which was an inspiration to his gun crew. During one of these attacks another member of the gun crew fell across Leading Aircraftman Tucker's shoulder, mortally wounded, but neither this nor the enemy's fire could deter him from his task. His gun shot down one enemy aircraft and damaged two others. Some days later the gun was rendered unserviceable by enemy dive bombers. Leading Aircraftman Tucker continued to defend the position as best he could with a rifle. He fell into enemy hands whilst in hospital after being wounded.

C.A.S. at Glasgow

AT the opening of the City of Glasgow Territorial and Auxiliary Forces Association exhibition at Kelvin Hall, Glasgow, on February 20th, the Chief of the Air Staff, Marshal of the Royal Air Force Lord Tedder, said: "In the old days, when the law of the jungle was more obvious than it is now, and we lived in smaller and more compact communities, people had to depend on the courage and skill at arms of their immediate families and friends. Our earliest forebears here in Glasgow no doubt had their Home Guard to protect them against the attacks of the Picts and Norsemen. Defence was based on local interest and loyalties and focused round castles built at suitable strategic points. In those days every able-bodied man periodically attended a locally organized wapinschaw—a good old Scots word. The wapinschaw was a parade of the local Home Guard to see that each man was armed in accordance with his rank, and ready to take the field when required.

In Hitler's war we found, I think to many people's surprise, that instead of war being purely a matter for professionals, it had now once again become a matter for every able-bodied man and woman. But we were unready for it, and at first we had Home Guard armed with pikes and anti-aircraft gunners without guns, and so on.

"Here are no pikes or wooden guns. I would say that at no previous showing of arms on Glasgow Green, before Bannockburn, during the '45 or in 1939, has such good equipment been available for our wapinschaw. One has often heard the phrase 'give us the tools and we will finish the job'—here the position is reversed—here are the tools, it's up to us to find the men—the hands and the brains. Here are anti-aircraft and radar weapons with which your local units are to protect Glasgow and the Clyde as a first task. Here are first line aircraft of both R.N.A.S. and your famous 602 Fighter Squadron."

Vampire Tropical Trials

AN R.A.F. Vampire has started tropical trials at Singapore. A second Vampire is remaining grounded to permit assessment of the effect of weather on the airframe.

B-29s Intercepted

SIX Boeing B-29 Superfortresses of the U.S. Army Air Forces, flying from Germany, were intercepted by R.A.F. fighters when they crossed the coast at Brighton recently on exercises.

Inter-service Ski-ing

THE British Air Forces of Occupation ski Team won third place in the Inter-Services Ski-ing Championships held recently at Garmisch, in the Bavarian Alps. British Army, Control Commission, Norwegian and Belgian teams also competed. The R.A.F. team was placed 10th, 13th, 14th, 15 and 16th in the down-hill race, and 9th and 15th in the slalom. The team comprised Sgt. P. Seitz (Captain), F/L. J. Verbeke, F/O. E. Stransky, Cpl. F. Ainstein and LA/Cs H. McCormack, R. Brestley and H. Wall (reserve). Some members started ski-ing only last year, and the team's training was considerably hampered by poor weather.

R.A.F. Bomb Home Fleet

UNITS of the Home Fleet were located and "bombed," and one submarine was located, by aircraft of R.A.F. Coastal Command during an exercise in the Bay of Biscay which began on February 17th. On the first day, Sunderland flying boats, engaged in an anti-submarine role, located one submarine. Later a Lancaster from St. Eval, Cornwall, located the Fleet in the Bay, and the ships were "shadowed" until daybreak, when Lancasters of another Squadron were "homed" on to the Fleet by the shadowing aircraft and made a high-level bombing strike, after which contact was broken.

In the afternoon the Fleet was again

Service Aviation . . . . .

located by a Sunderland from Calshot which homed on a Lancaster from St. Eval to continue the shadowing before the exercise was broken off.

Blood Donors

DURING the past 12 months nearly 2,000 R.A.F. recruits passing through the centre at West Kirby, Cheshire, have given blood to the National Blood Transfusion Service.

V.R. and Auxiliary Help for A.T.C.

TO help in the instruction of A.T.C. units, arrangements have been made for members of the R.A.F.V.R. and R.Aux.A.F. to volunteer as instructors up to a maximum of 44 hours a year. Attendances will count for training and travelling expenses allowances, and towards the annual bounties.

R.A.F. Food

THE Secretary of State for Air, Mr. Arthur Henderson, visited R.A.F. Station, Halton, on February 20th and spoke of the way in which the Service could help itself to make good some of the cuts that had been made in rations. Mr. Henderson had this to say to the cooks of all units: "The new ration scale gives everyone in the Royal Air Force the same calories as they had before, but it is up to you cooks to turn these calories into attractive dishes. Your watchword has got to be 'ingenuity.' This switch over from dollar food items represents a challenge to your skill as cooks, and I am sure the whole Service will be closely watching to see how you respond."

Speaking to the officers and airmen, Mr. Henderson said that they could mitigate the cuts if each Unit garden produced a greater quantity of food. "Here, at this magnificent station," he said, "you have a Unit garden of which any station might be proud. Last year it contributed to the £125,000 worth of food produced by the R.A.F. which, in spite of the reduction in the size of the Force, showed an increase of £30,000 over the figure for 1946."

Reunions

THERE will be a 644 Squadron Dance on April 10th at the "Goat and Compasses," 341, Euston Rd., London. Details can be obtained from the Hon. Sec., B. R. Tough, 9, The Crescent, Egham, Surrey.

* * *

The second annual reunion of No. 514 Squadron will be held at the Horseshoe Hotel, Tottenham Court Rd., London, W.1 on April 17th at 6.30 p.m. Tickets, 10s 6d each, from R. A. Baxter, 2, Southey Rd., Worthing, Sussex.

* * *

The number of the Servicing Echelon mentioned in the notice concerning the 157 Squadron reunion, published in these pages last week, should have read 6157, *not* 3081.

R.A.F. Victory Over Navy

IN the season's first inter-Service Rugby football match which took place at Twickenham on February 21st, the weather had a considerable influence on the game. However, the R.A.F. deserved their 16 points to 11 victory, and the score is quite representative of the game. Bitterly cold wind and snow flurries made hands stiff and blue and kept all but a few hundred spectators away.

Within a few minutes of the kick-off the R.A.F. went ahead with a penalty scored by Smailes, their full back. The Navy forwards then got busy and in addition to getting the best of the loose scrums they harassed Hay, the R.A.F. scrum half whose service to Plumb suffered for a time. From the set scrums the R.A.F. seemed to get a little more of the ball, and but for the close marking of both pairs of centres scores might well have been higher. There were scarcely any forward rushes by either team throughout the game, the tendency being to feed the outsides even when defending inside their own twenty-five.

Quite early in the game Douglas, the large, hard-running R.A.F. wing who proved difficult to pull down, and is probably faster than he looks, made one particularly good run, and pressing hard the R.A.F. used the ground gained to increase their lead to seven points through an excellent drop goal by Crerar. Just previously, a good Navy run had narrowly missed scoring, but a penalty given under the R.A.F. posts gave the Navy their first three points. Murphy O'Connor with an unorthodox kicking technique just succeeded in swerving the ball over the bar.

The Navy now struck their best form of the afternoon, and a very good movement following an interception by Bennett, the international, resulted in an unconverted try by Lewin.

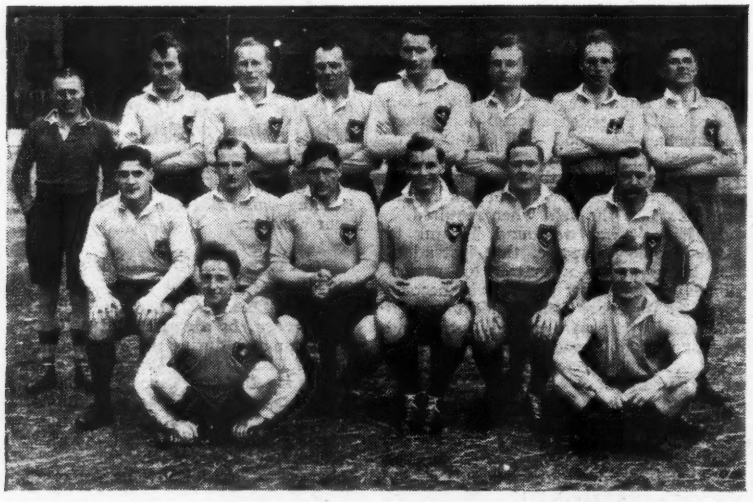
The score remained at 7 to 6 points to the R.A.F. until shortly after half-time when, with the Navy getting most of the ball and the R.A.F. forwards and halves playing a scrappy game, Smailes failed to reach a Navy kick ahead and, hesitating for a vital moment, was too late to follow the leg bounce and McLennan touched down near the posts. This was the try Murphy O'Connor converted, and the Navy went into the lead with 11 points to 7. On the play at that time the Navy appeared to have the game in hand. However, the ball soon came out to Douglas, the R.A.F. wing, from a scrum near the centre of the field. He ran to the right, but finding his way blocked, threw out a very long pass across the field to Cannell on the left, and he, with an excellent burst of speed, rounded the Navy defence and secured near the corner flag. Smailes, whose place kicking was excellent, made a glorious conversion to give the R.A.F. a 12 to 11 point lead.

This was the turning point for the whole R.A.F. side who now attacked vigorously, Plumb and Crerar both making some fast elusive runs. Quite soon a long, low drop kick by Crerar skimmed over the bar to put the R.A.F. score up to 16 points to the Navy's 11.

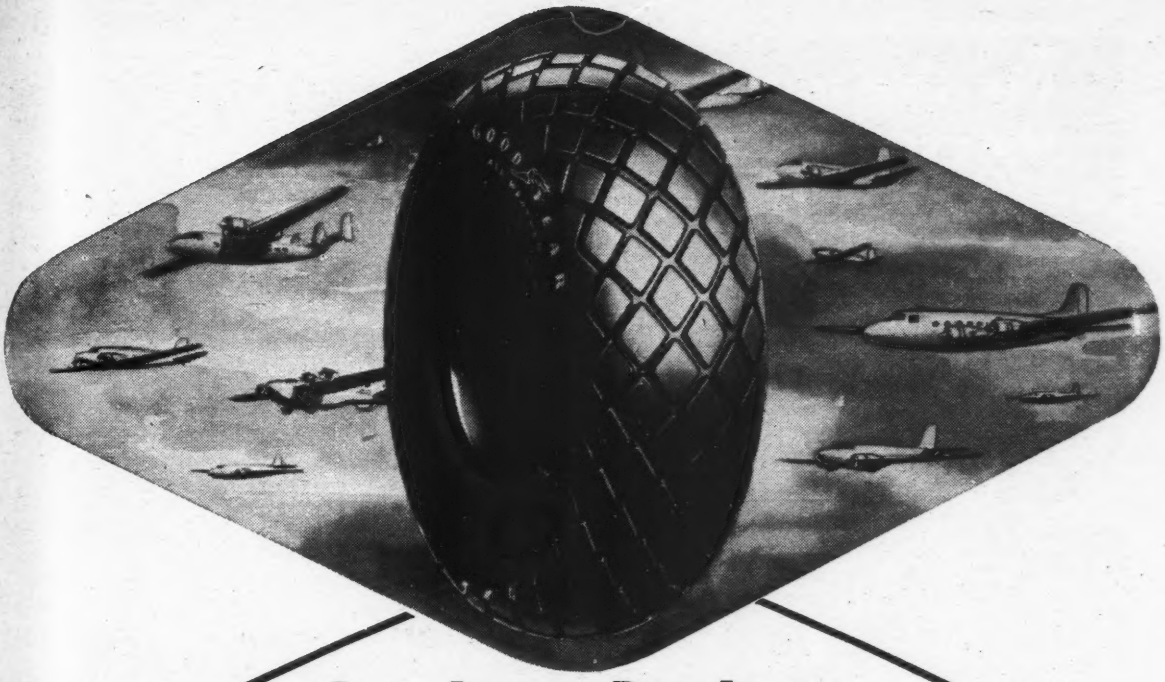
A number of mistakes were made during the game, and although the tackling was good in the centre on both sides the R.A.F. gained ground on several occasions from kicks ahead because the Navy outsides were slow to turn in defence. The R.A.F., whose wingers, including Weighill the captain, did some particularly useful spoiling work on the Navy halves, might have taken better advantage of the Navy tendency to knock the ball back from the line out.

Of the 22 matches played since 1920 the Navy have won 16 and the Royal Air Force four, two being drawn. On March 6th the Royal Navy meet the Army, and on April 3rd the Army play the R.A.F. Both matches take place at Twickenham and the kick-off is to be at 3 p.m.

M. A. S.



THE R.A.F. TEAM: L. to R. (Back Row), Mr. A. W. C. Austin, Referee, F/L. W. E. Thompson, F/L. J. Steele, L.A/C. A. H. Burcombe, F/L. E. C. K. Douglas, F/O. A. M. Whittington, F/O. R. Watson, A/C. R. G. Crerar. (Middle Row) P/O. L. B. Cannell, F/L. A. A. Smailes, S/L. C. H. Beamish, F/L. R. G. H. Weighill, F/L. E. L. Horsfall, S/L. F. W. Higginson. (On Ground) F/O. S. Plumb, F/L. W. T. H. Hay.



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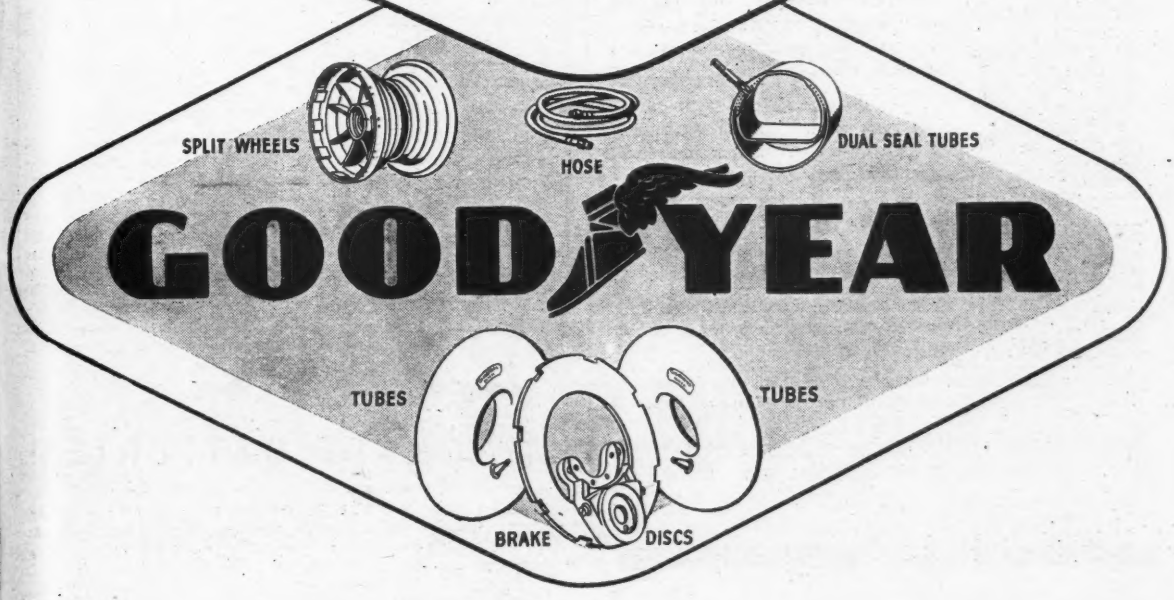

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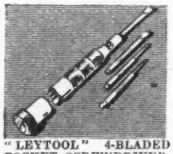

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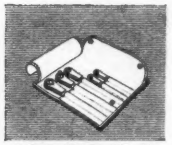

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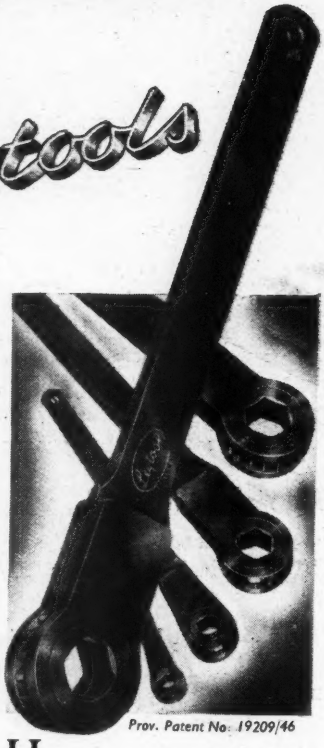

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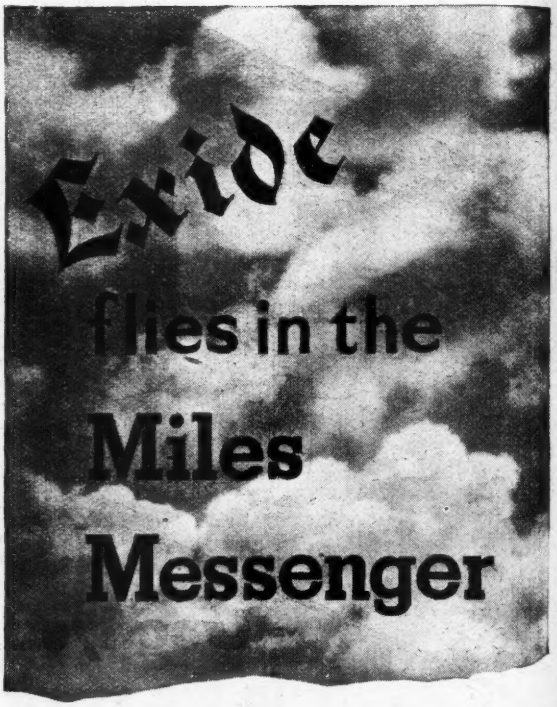

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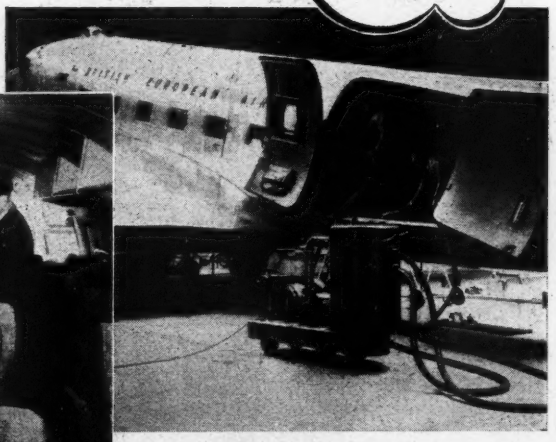

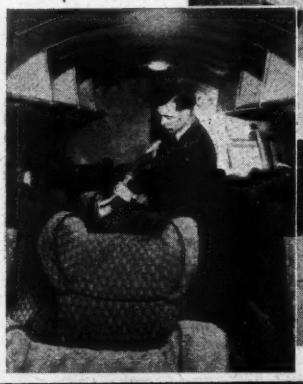

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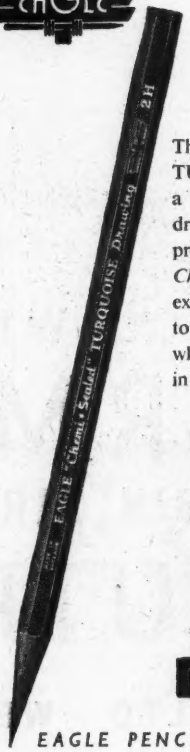

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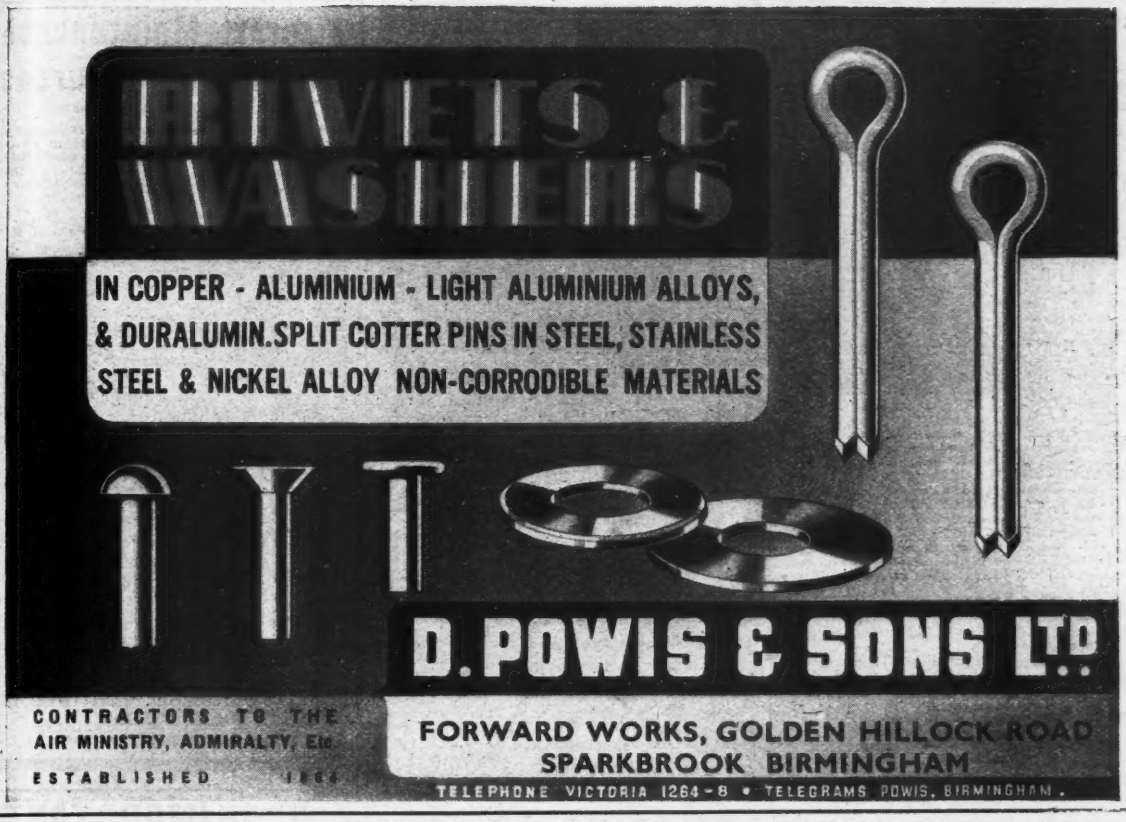
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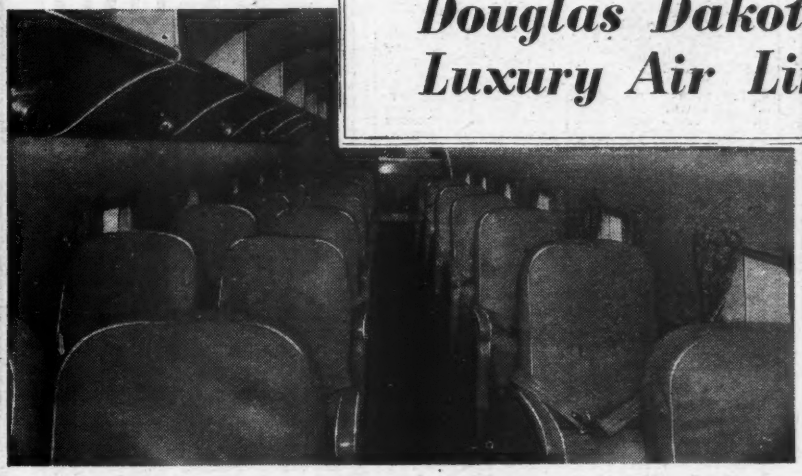

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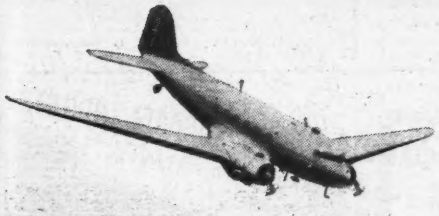

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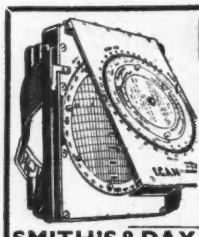

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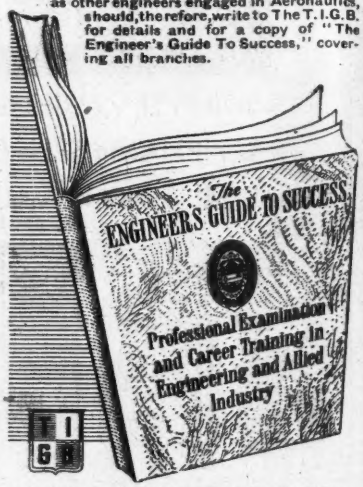

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GLOSTER AIRCRAFT Co. have notified to the Ministry of Labour the following drawing office vacancies :—

10 Senior Draughtsmen.

20 Draughtsmen.

APPLICATIONS addressed to Employment Manager Gloster Aircraft Co., Ltd., Hucclecote, Glos., will be handed to the Ministry of Labour for routine disposal after consideration. [1493

HORNTON AIRWAYS, Ltd., require one Rigger Carpenter.—Reply to Brook House, Park Lane, W.1. Tel. Mayfair 6212. [1494

APPLICATIONS are invited from senior draughtsmen and stressmen.—Apply in writing or by telephone to Labour Manager, Vickers-Armstrongs, Ltd., Weybridge Works, Weybridge. Tel. Byfleet 240. [1309

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ROYAL NAVY—Short Service Commissions in the Instructor Branch.

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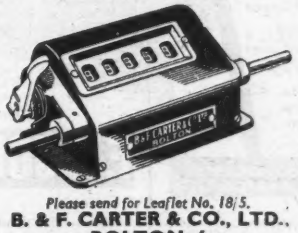

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TECHNICAL and drawing office personnel are required for work in Australia on the design of small high-speed, jet-propelled aircraft.

THE positions advertised are of a temporary character at present, a minimum period of 5 years' employment being offered, subject to satisfactory performance of duties. The salary offered will be within the classifications approved, and determined having regard to qualifications and experience. Applicants must be British subjects and medically fit. A medical examination may be required.

THE provisions of the Re-establishment and Employment Act, 1945 will apply in the selection of applicants.

THE work will be carried out at Fishermen's Bend, Melbourne, Victoria, and the cost of the sea passage of the successful applicants (including wife and family) will be borne by the Commonwealth.

APPLICATION forms should be obtained from the office of the Deputy High Commissioner, Australia House, Strand, London, W.C.2. Applications will close on March 31st.

THE following positions are offered :—

TWO (2) senior stressmen. (£A721-£A924.)

APPLICANTS must have a degree in engineering or be an associate fellow or member of an approved institution. They should also have had not less than five years' experience of general and detail stressing, preferably on high-speed aircraft.

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TWO (2) senior draughtsmen. (£A676-£A811.)

APPLICANTS must have had not less than 5 years' experience on general layout and detail design work, preferably on aircraft of the high speed fighter type. [1498

EXPERIENCED Dakota captain required, must possess B and 2 N, previous civil experience essential.—Apply to Box 6135. [1501

STRESSMEN required.—Apply, stating qualifications, experience and age, to Personnel Officer, Westland Aircraft, Ltd., Yeovil. [1435

JIG and tool draughtsman required on South Coast, preferably man with aircraft experience of large assembly jigs; only first class man need apply.—Write, stating age, full details of experience and salary expected, to Box 6134. [1500

RATEFIXER required by large aircraft firm in the West London area, successful applicant must be capable of pricing a large and varied range of work in experimental machine shop.—Write stating experience and salary required to Box 5968. [1462

THE DE HAVILLAND ENGINE Co., Ltd., require design and detail draughtsmen, preferably with experience in gas turbine and/or reciprocating engines —Apply Personnel Office, De Havilland Engine Co., Ltd., Stag Lane, Edgware, Middx. [0400

FERRY Pilot required end of March to fly Proctor to Middle East; salary and expenses will be paid during trip, etc., plus bonus if no undue delays. —For further details apply by air mail to Chief Pilot, The Contracting and Trading Co., Beirut, Lebanon. [1496

SAUNDERS-ROE, Limited, have vacancies for senior design draughtsmen, stressmen and aerodynamicists.—Applications stating age, qualifications, experience and salary expected should be sent to Personnel Officer, Saunders-Roe, Limited, East Cowes, Isle of Wight. [0394

JIG and tool draughtsmen; senior jig and tool draughtsman with sheet metal, planning and tooling experience, and two experienced jig and tool draughtsmen required.—Apply Personnel Office, The De Havilland Engine Co., Ltd., Stag Lane, Edgware, Middx. [0404

WANTED.—Technician with a degree in mechanical engineering for work on aerodynamics, experience desirable but not essential.—Apply, stating age and salary required to the Chief Draughtsman, The English Electric Co., Ltd., Aircraft Division, Corporation St., Preston. [1505

AIRCRAFT development fitter required by East Anglian Company, must possess minimum of 8 years experience in aircraft assembly-fitting, preferably in development department of aircraft factory and have served apprenticeship in this trade.—Write, stating age, full particulars of experience, etc., to Box 5996. [1472

THE DE HAVILLAND AIRCRAFT Co., Ltd., Hatfield, have a few vacancies for experienced detail designers and senior aircraft draughtsmen.—Applications, stating age, experience and salary required, should be marked "Aircraft," and addressed to the Chief Draughtsman, The De Havilland Aircraft Co., Ltd., Hatfield Aerodrome, Herts. [1350

HANDLEY PAGE, Ltd., have vacancies on their staff for technicians, including stressmen and aerodynamicists—preferably degree standard as well as senior design draughtsmen for extensive programme of very interesting work; good salaries and conditions; experience to Staff Officer, Handley Page, Ltd., Claremont Rd., Cricklewood, London, N.W.2. [1242

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APPLICATIONS are invited for senior draughtsman-designers for posts in the project design section; work is of an interesting and varied nature connected with the aircraft installation of gas turbine and other engnes; applicants must hold Higher National Certificate or equivalent qualifications and must be capable of preparing designs ad initio.—Apply to Personnel Manager, D Napier & Son, Ltd., Luton Airport, Beds. [1450

BRITISH OVERSEAS AIRWAYS CORPORATION require a technical instructor at Hurn Airport, near Christchurch, Hants, in connection with the training of pilots, flight engineers and licensed ground engineers; the essential qualifications are a sound educational background including an engineering degree preferably in aerodynamics or Fellowship of the Royal Aeronautical Society; in addition the following is desirable: three or four years practical experience in the aircraft industry, including flying, but not necessarily as a pilot; knowledge of modern teaching methods and technique and ability to correlate and write technical data; salary £660 rising to £930 p.a., according to qualifications and experience; applications in writing to Staff Appointments Superintendent, Stratton House, Piccadilly, W.1 (marking envelope "Technical Instructor"), enclosing stamped addressed envelope for reply and giving details of age, education, engineering qualifications, degree, etc., and past experience; closing date 2 weeks after the appearance of this advertisement. [1479

SITUATIONS VACANT

SENIOR stressman required.—Please send details of training, experience and salary required to Chief Technician, Gloster Aircraft Co., Ltd., Witcombe, Glos. [0369

AERODYNAMICISTS required immediately, apply giving particulars of past experience, age, and salary required to Personnel Officer, Westland Aircraft, Ltd., Yeovil. [1342

A limited number of ground engineers, holding A and C licences, required for servicing Viking aircraft overseas.—Apply by telephone or in writing to Labour Manager, Vickers-Armstrongs, Ltd., Weybridge. [1457

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THE FAIREY AVIATION COMPANY, Ltd., Hayes, Middlesex, having a progressive and expanding programme in a wide field of aeronautics, invites applications from aerodynamicists, and stress analysts with initiative and enterprise and upwards of three years' experience; there are also a few vacancies for juniors with a knowledge of theory and design of structures, 38 hour 5-day week, pension scheme.—Apply, stating age, experience and salary required, to the Personnel Manager. [1458

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CHIEF Designer (aircraft) would consider new executive appointment, aircraft or allied firm, design, expl., or tech, admin.—Write in confidence to Box 6111. [1485

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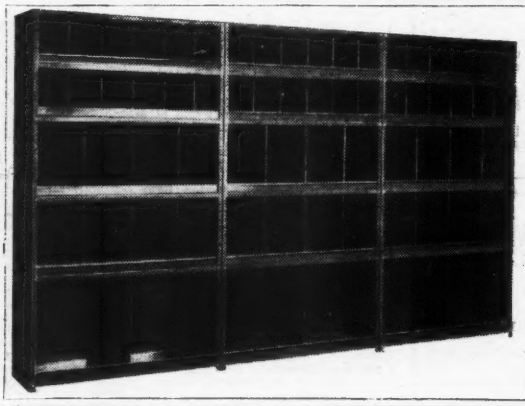

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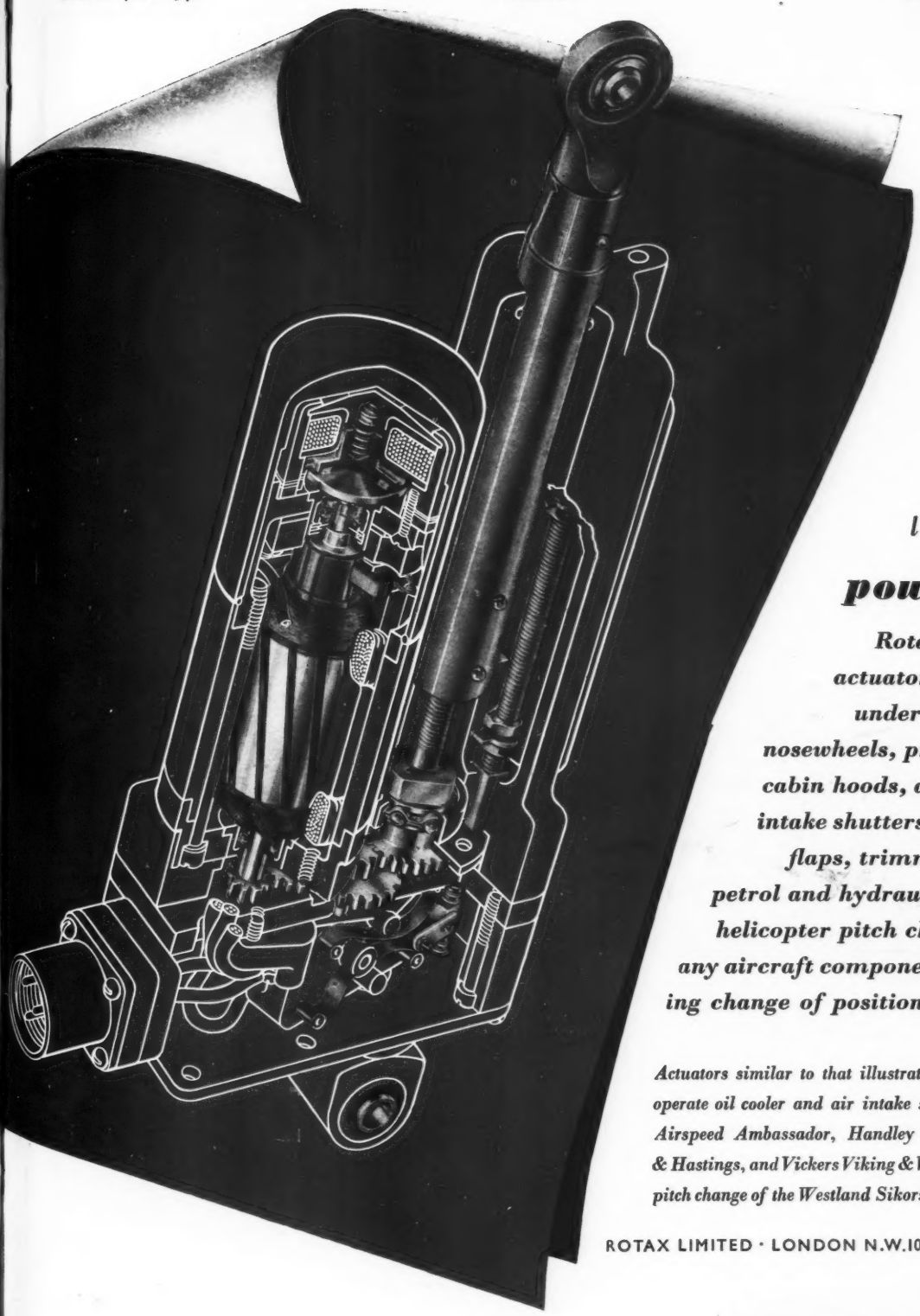

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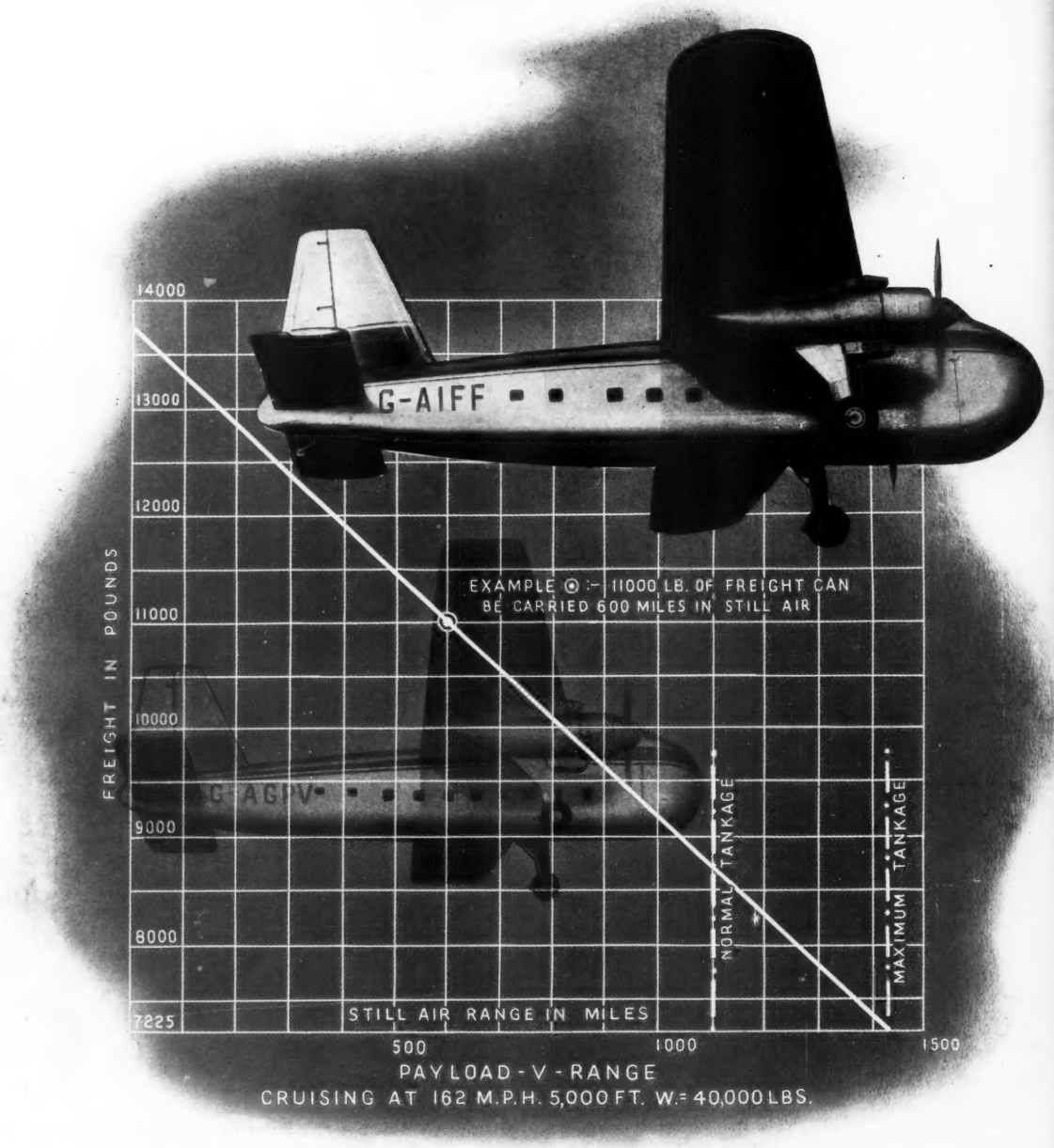

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